

An Integrated Electronic/Paper Document Lifecycle

by

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Submitted to the System Design and Management Program in
Partial Fulfillment of the Requirements for the Degree

of

Master of Science in Engineering and Management

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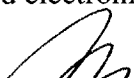
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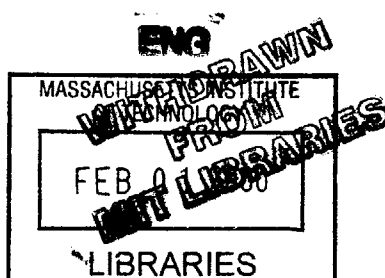
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Abstract

Today, there has been an on going effort to include paper's convenience for electronic documents, by the addition and improvement of functions in software, and development of mobile devices. However, these movements are only alternatives of particular functions of paper. Paper is still the most flexible and user-friendly media.

This project has analyzed the usage forms of business documents, and proposes a new document lifecycle based on the mutual relationship of electronic documents and paper documents. Furthermore, from this standpoint, electronic documents and paper documents complement each other. It is important to set up the base of mutual circulation of electronic documents and paper documents. This thesis provides an overview of the new document lifecycle concept, which enables users freely to choose types of documentation media they use, in response to their needs.

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Introduction

With the advancement of office automation, such as the availability of better performing personal computers, there is an increase in the amount of electronic documents created by word processor and spreadsheet applications. In addition, with the rapid deployment of use of Internet, the volume of distributed electronic documents is also increasing. Under such circumstances, there was an initial prediction of reduced usage of paper documents. However, the trend is showing an increase in paper documents in the form of electronic document printouts.

In this project, firstly, a customer survey was conducted to understand the reason why paper documents are still being used, under what condition they are used, and the status of their relationship with electronic documents. Based on the analysis of the survey results, the document lifecycle, focusing on the relationship between the electronic documents and paper documents, was defined.

Second, In order to develop the important technical requirements for an ideal document lifecycle, the first level and the second level Quality Function Deployment (QFD) Matrixes, such as the QFD Requirements Matrix and the QFD Product Design Matrix, were conducted.

Finally, two different new document lifecycle concepts were proposed, which are the mobile electronic document concept and the integrated electronic/paper document concept. The first concept focuses on developing an advanced mobile device that allows more user-friendly electronic document processing. The second concept focuses on the cooperative usage of electronic documents and paper documents, and this document lifecycle concept enables users freely to choose types of documentation media they use, in response to their needs.

Customer Survey

In order to understand the customer needs of document processes, a customer survey was conducted [Burns1995]. First of all, individual interviews were conducted with five engineers. They were asked to express freely how they read, write, and edit documents during their current working circumstances, as well as their complaints and requirements at the same time. Then, for a broader perspective of customer needs and statistical data, a questionnaire was developed based on the result of the initial interviews. The developed questionnaire was reviewed by ten people including the initial interviewees. Based on their comments and suggestions, the contents and description of the questions were modified, and the final version of the questionnaire was completed.

Two identical questionnaires, an English version and a Japanese version, were created. The English version questionnaires were distributed via electronic mail to students and faculty members of the System Design and Management Program at MIT, where I am on a student. Additional requests for this questionnaire were forwarded to students in other programs within MIT, as well as to some international students who were my former classmates from previous schools.

The Japanese version was sent to my former colleagues at Fuji Xerox, especially in the software development department, as well as to my college classmates and friends.

Questionnaire

The questionnaire was made up with the following ten categories. Each question is basically a multiple choice of 4 or 5. In addition, some written answers were required. The average duration to answer the questionnaire was approximately 30 minutes.

1. Questions about your work.
2. Questions about preparation/editing electronic documents.
3. Questions about reading electronic documents.
4. Questions about preparation/editing paper documents.
5. Questions about reading paper documents.
6. Questions about printing electronic documents.
7. Questions about copying/capturing paper documents.
8. Questions about storing/distributing documents.
9. Questions about the comparison between electronic documents and paper documents.
10. Questions about overall document information.

The complete questionnaire, the result, and charts of the result are exhibited in Appendix 1, Appendix 2, and Appendix 3 respectively. In addition, the comparative charts of US vs. Japan are exhibited in Appendix 4. What follows is the contents of major questions, results of these questions, and analysis of the results.

Country

There were 101 replies to the questionnaire after a one-week period. The estimated rate of reply is between 10 and 20 percent.

Of the respondents, 42 were working in the United States, 52 were working in Japan, and seven were working in other countries (Argentina, Brazil, Colombia, Sweden, Taiwan, and UK).

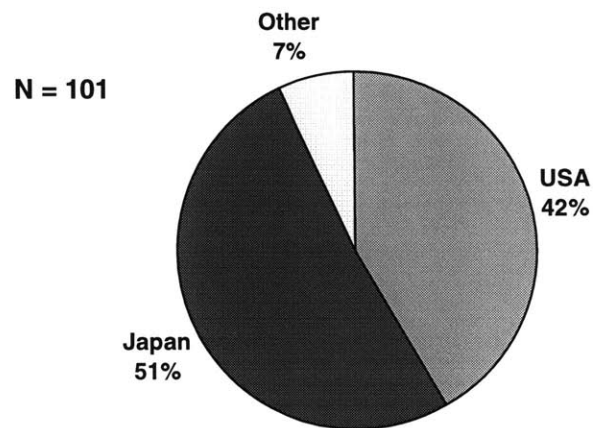


Chart 1: Country

Job type

- *Q1-2: What is your job type?*

To begin with the questionnaire, correspondents were asked to choose from the following job types.

- Research
- Product development
- Manufacturing
- Sales / Marketing
- Customer service / Support
- Planning
- Staff
- Other

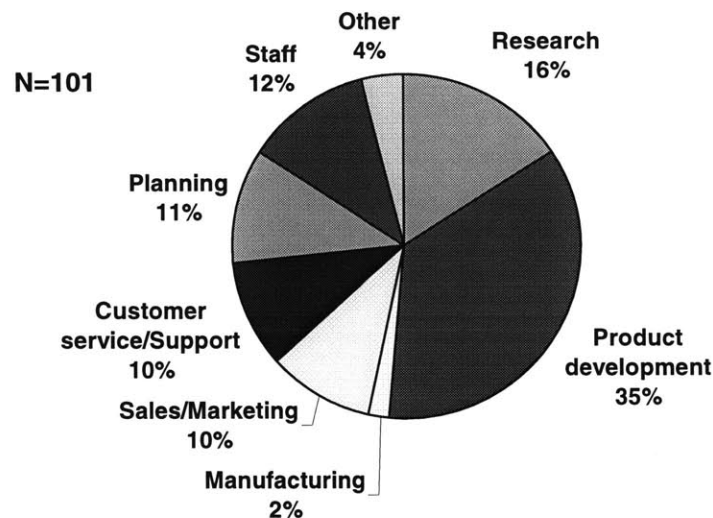


Chart 2: Job type

Since the majority of the correspondents were engineers, the total number of this category reached 51%, including 16% in Research and 45% in Product development. The rest of the job type categories were evenly distributed at around 10% each in Sales/Marketing, Customer service/Support, and Planning Staff.

Spend time

- *Q1-4.a: What percent of your job is spent reading documents?*
- *Q1-4.b: What percent of your job is spent preparing and editing documents?*

These investigations cover the percentage of work time spent processing and reading documents. For reading, and preparing/editing the document, correspondents were asked to choose one of seven percentage slots. Because the result was expected to be distributed around the lower percentage slots, the segmentation of these slots was not evenly set.

As the result, the distribution of both reading and preparing/editing categories concentrates around the 20 to 30% slots. The average values are 29.7% for reading and 27.2% for preparing/editing. This result shows that time spent for reading documents is slightly greater than that of preparing/editing. In addition, the combination of these two categories, which is the time spent on processing documents, exceeds more than half the total time spent on work.

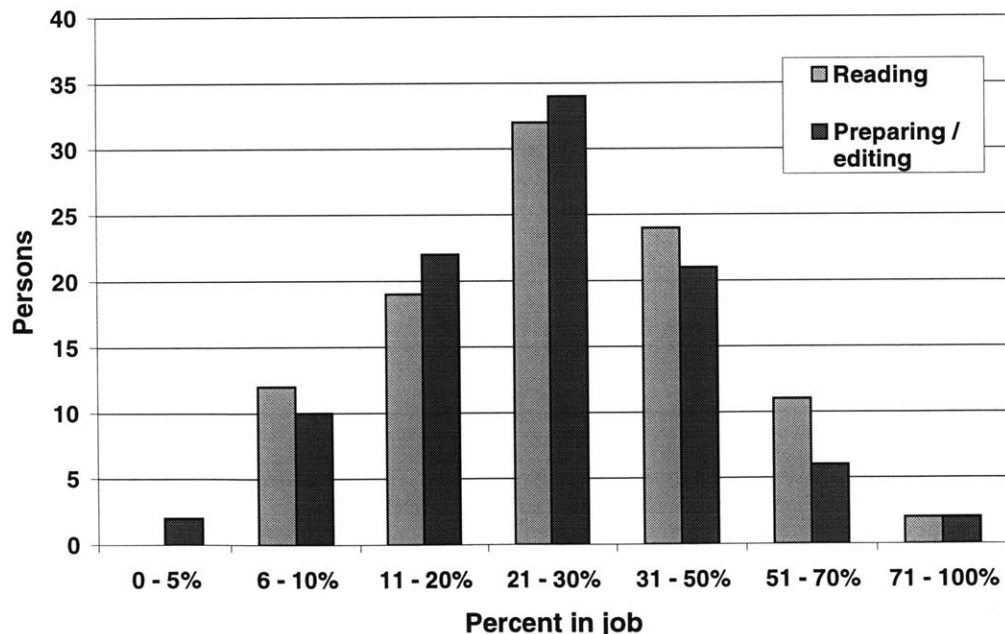


Chart 3: Spend time in document processing

Applications frequency

- *Q2-1: What kind of applications do you use to prepare/edit electronic documents?*
- *Q3-1: What kind of applications do you use to read electronic documents?*
- *Q6-1: What kind of applications do you use to print electronic documents?*

The next series of investigations cover the frequency of preparing/editing, reading, and printing documents based on using different types of applications. The frequency was divided into the following five segments for evaluation: 0:Never, 1:Yearly, 2:Monthly, 3:Weekly, and 4:Daily.

The following 11 applications were indicated as default categories for the survey.

- Electronic mail (Outlook, Notes, Eudora, etc.)
- Word processor (Word, etc.)
- Spreadsheet (Excel, etc.)
- Presentation editor (PowerPoint, etc.)
- Graphics editor (Photoshop, etc.)
- HTML editor (FrontPage, etc.) / the Web browser (Netscape, Internet Explore)
- Source code editor (VisualBasic, etc.)
- Data sheet / Form editor (Access, etc.)
- PDF editor / reader (Acrobat editor/reader, etc.)
- CAD editor (AutoCAD, etc.)
- Text editor (Memopad, etc.)

Within the above categories, the usage frequency of Graphics editor, Source code editor, Form editor, and CAD editor did not reach the average of 1:Yearly. As a result, these categories were omitted from the graph chart.

For all the applications, time spent on reading showed the highest value. The reason for this result is conjectured based on the increase in the volume of the electronic documents such as electronic mails and the Web-based contents caused by the popularity of Internet

rather than the increase of electronic documents created by the larger number of personal computers available.

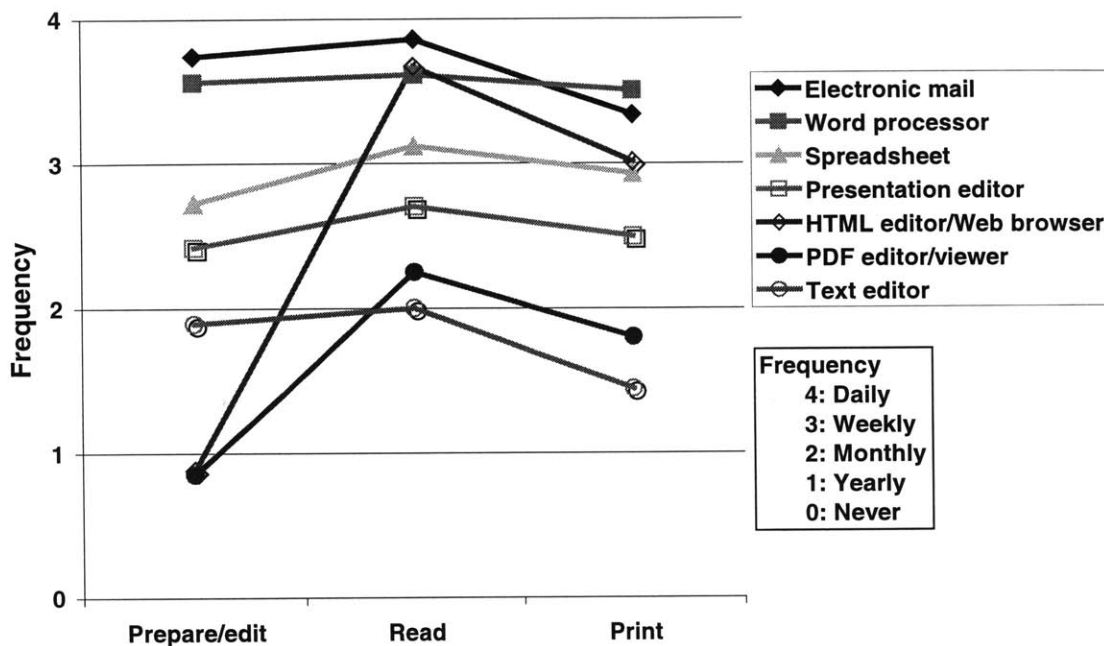


Chart 4: Applications frequency

Both electronic mail and word processors are used almost on a daily basis. However, when it comes to the printing of these documents, the frequency of printing electronic mail documents is clearly lower than reading the same documents on the monitor screen, while it remains almost equal for a word processing application. This tendency also relates to a later result of the survey. Electronic mail documents are easy to read since they use relatively big fixed size fonts with simple layouts. Therefore, reading on the screen is a very common practice. Printing is often performed for the purpose of reading the documents later or carrying the documents.

On the other hand, word processing documents require more frequent printing because of the following three reasons.

1. Difficulty reading the documents on the screen, because of the use of small fonts having relatively complicated layouts.
2. Annotation is often performed.
3. Proof reading of the document contents and verification of the layout.

Except for the fact that the usage frequency is relatively lower, both the Spreadsheet application and Presentation editor showed a similar pattern to the word processing application. This tendency of lower usage frequency can be expected because of more operation specific usage of the Spreadsheet and Presentation editor, compared to the word processor that is widely used for more general purposes. The reason for printing should be the same as for word processing applications.

The reason for very low usage frequency for both the HTML editor and PDF editor was because these applications were only used in a limited work activity for creating documents for display purposes. In addition, because of its display format characteristics on screen, it made sense that there was a lower frequency of printing compared to reading. Although the main objective was to display on the screen printing frequency was not that low. This was probably because of reading and future purposes, just like electronic mails

Again, the use rate for displaying HTML (naming the Web browser applications such as Netscape Navigator) reached almost the same level as electronic mails. On the other hand, it's clear that PDF viewers are not yet widely used as the frequency stopped at the monthly level.

The use pattern of text editors had a similar pattern with electronic mail for the same reasons. Once text editors were used widely for creating documents for their ease of use, speed, and reduced resource burden. Now, with the advancement of word processing applications and the availability of higher speed CPUs and larger memories and hard drives, most document preparation is initiated directly using a word processor. Therefore, the overall use of text editors has become less frequent.

Audiences/Authors

- *Q2-2: Who is the audience of the electronic documents that you prepare/edit?*
- *Q3-2: Who authors the electronic documents you read?*
- *Q6-2: Who creates the electronic documents you print?*
- *Q4-2: Who is the audience of the paper documents that you prepare/edit?*
- *Q5-1: Who authors the paper documents you read?*

These investigations covered the target audience for preparing/editing of documents. Types of authors of documents for reading, for both electronic and paper documents were also considered. Furthermore, types of authors were also investigated for printing of electronic documents

The four categories of target audiences and authors were:

- Myself (correspondent)
- The team, the project, and the division that correspondent belongs to
- Other divisions
- Outside of the company

Five levels of frequency were: 0:Never, 1:Yearly, 2:Monthly, 3:Weekly, and 4:Daily.

For electronic documents, the work activities of preparing/editing for the team and reading documents that the team and/or project members created, showed the highest frequency. This reflected the fact that many of the correspondents belonged to and worked on groups, and electronic mails for business matters and meeting schedules were being distributed on a daily basis. The frequency of printing documents created by team members remained almost equal to reading them on the screen. The presumption of this phenomenon of printing to papers should be the documents' direct relationship to a correspondent's work activities including making comments, annotation and storing as a hardcopy.

Following with just a narrow margin, there were self-usage activities of reading and

writing documents for the purpose of gathering ideas and recording. This was because; (1) the spread of personal computers and palm top computers used exclusively for individuals, and (2) the work style of using electronic documents directly instead of papers and pencils, even at the initial thinking stage, has gained popularity.

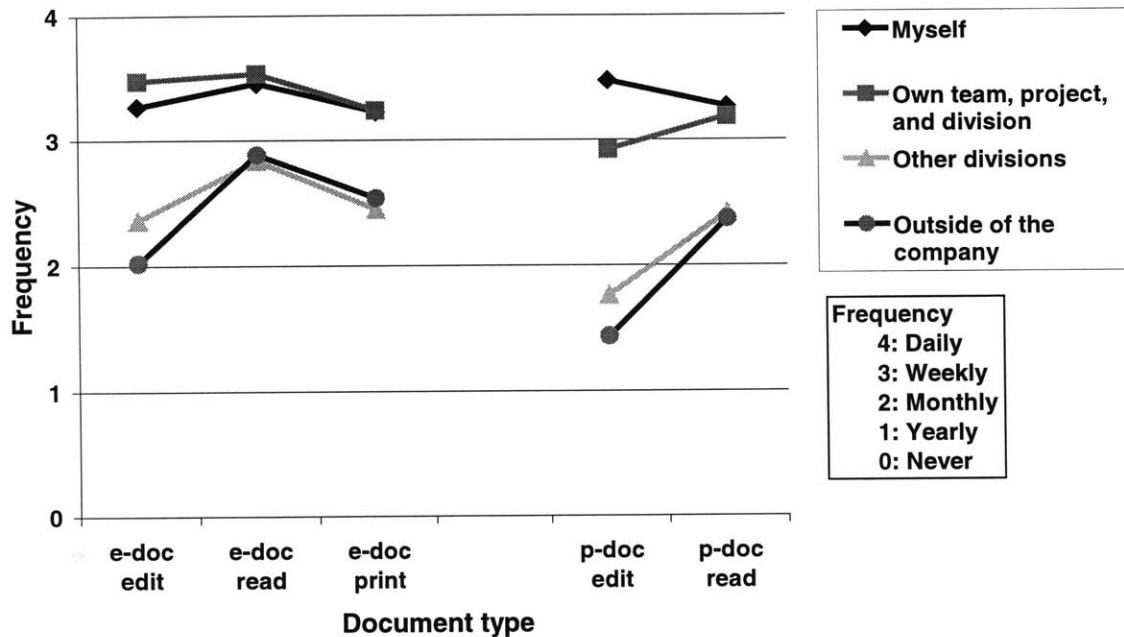


Chart 5: Audiences/Authors

Regarding other divisions, the frequency of exchanging documents was relatively lower than within a division. The preparation of documents for other divisions was especially lower at the monthly level. It was assumed that most of the documents for other divisions are relatively formal so the total volume produced is less, compared to more informal documents for internal group use. The result showed the frequency of document preparation for outside of the company was about equal to that for other divisions. This was probably caused by the spread of reference and information search using the Web. This could also be explained by the fact that compared to the result of other divisions, the frequency of reading documents was higher while that of preparation was lower. Moreover, the relative drop in volume of documents printed from external sources compared to personal and group materials could be assumed for these external documents' role as a reference rather than adding comments and annotation.

The distinctive result regarding paper documents showed that the correspondents' frequency of creating documents, targeting themselves as audiences was higher than reading the created documents. Instead of just preparing documents, as media, the paper was used as a supporting tool for intellectual creative activity, with idea generation in mind. Furthermore, the frequency of preparing documents in paper for self-use is slightly higher than for electronics. This indicated that thought processes using paper and pen are still the main way of operating.

The frequency of preparation of paper documents for team members was relatively lower at a weekly level, compared to electronic documents. This suggested that even informal documents for discussion purposes have been changing to electronic forms. In addition, the frequency of reading paper documents from team members has not shown much drop from the case of electronic documents. This is explained by the fact that electronic documents created by team members are being printed, in order to be distributed at team meetings as well as for writing comments after thoroughly reading.

Paper document preparation for both other divisions and other companies remained very low at less than a monthly level. Because of the nature of these formal documents, they are created with some electronic means such as using a word processing application, requiring a certain level of quality and design aspects, such as layout and usage of fonts. At the same time, the frequency of reading paper documents from other divisions and other companies remained equal with the frequency of printing electronic documents from other divisions and other companies, including printed matters such as magazines and reports.

Locations

- Q2-3: Where do you prepare/edit electronic documents?
- Q3-3: Where do you read electronic documents?
- Q4-3: Where do you prepare/edit paper documents?
- Q5-2: Where do you read paper documents?

For both electronic documents and paper documents, the location where preparing/editing and reading take place was investigated.

The four location categories were:

- Desk
- Office (workplace, meeting room)
- Home
- Other (Commuter time, etc.)

While five-frequency levels were: 0:Never, 1:Yearly, 2:Monthly, 3:Weekly, and 4:Daily.

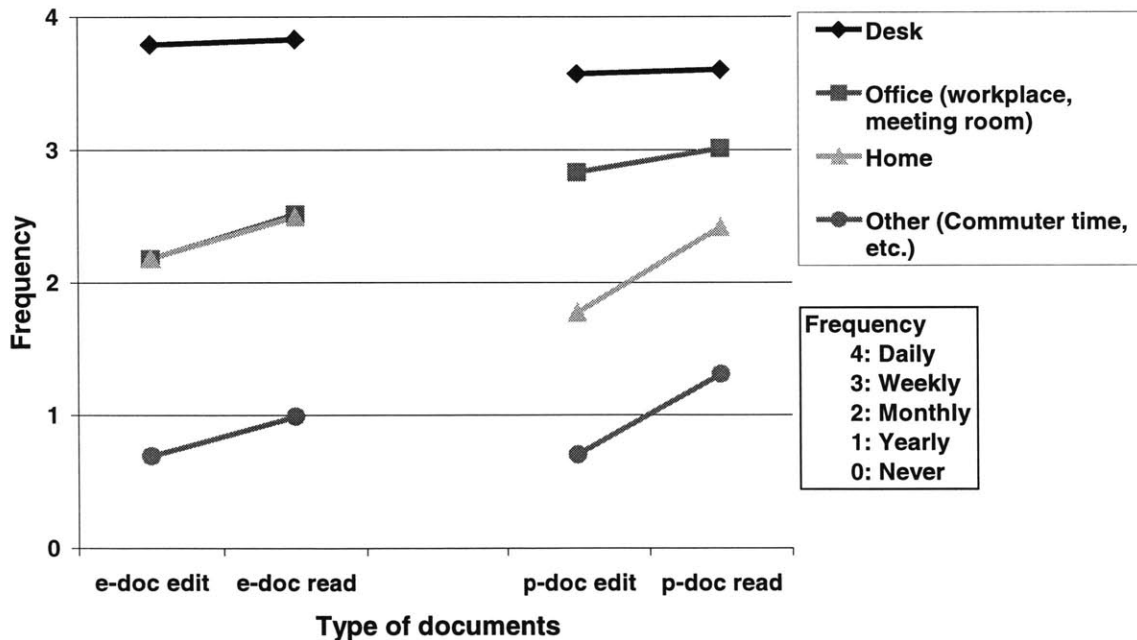


Chart 6: Edit/Read document locations

Individual personal computer usage was really reflected in this case, as the frequency of electronic document read/write activity at ones own desk was extremely high on almost a daily basis. On the other hand, the frequency of read/write activity of electronic documents in a public office space such as a meeting space remained low, especially document preparation on monthly basis. This indicated the slower deployment of the computing environments at public work places, such as meeting rooms.

At home, the frequencies of electronic documents read/write activities were almost equal to the ones in the office environment. Considering that this survey did not include private electronic mail and the Web browsing other than business related, this phenomenon indicated the maintenance of a computing and network environment at home has been progressing. As working forms evolve in the future, such as the spread of home offices, the frequency of read/write activities of electronic documents at home can be expected to be even greater.

Through the wide spread use of Notebook personal computers and palm top computers, the frequency of read/write activity of electronic documents during commuting and at outside locations remained very low at less than a yearly basis. This indicated that the wave of mobile computing was not yet gained in popularity.

As for the frequency of read/write activity of paper documents, ones own desk was the most frequent location and this was the same as for electronic documents. However, unlike electronic documents, there were not many differences between at public work place, such as meeting rooms at a weekly work frequency. This must be reflecting the typical work style, such as distributing printouts of electronic documents, sharing the information, and discussing the contents during team meetings.

Compared to the frequency of preparation at home, during commuting and at outside locations, paper documents were not as common at each location compared to electronic documents. However, the reading frequency, in reverse, showed a higher trend. It does not require bringing the intellectual creative activity (such as idea generation) to home

but the activity is done at workplace, which using paper documents as their principal. The frequency of reading printouts using spare time such as commuting time is still higher than the frequency of reading electronic documents using mobile devices.

Type of printers

- Q6-3: What do you print electronic documents on?

This investigation covered what types of printers being used.

The result showed that monochrome printers connected to the network were overwhelmingly used on almost a daily basis. Networked color printers followed with monthly frequency. Both monochrome and color printers connected locally stayed less than a yearly frequency. Because of the implementation of operating software with printing service functions, namely Windows NT and NetWare, at the work place, it has become a much easier environment to use the network printers.

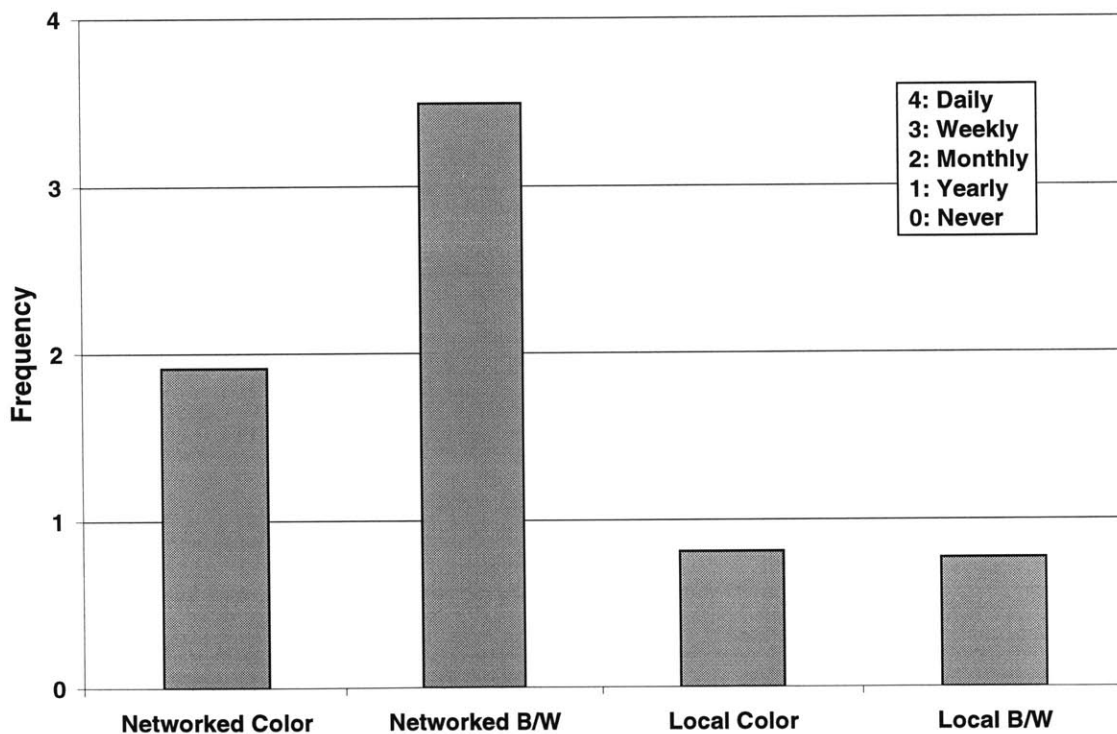


Chart 7: Type of printers

Within the usage frequency of network printers, 93% answered that they had used monochrome printers. When combining daily and weekly, the number reached 89%. That indicated the regular usage of this particular type of device. On the other hand, for color printers, the answer of 73% was not that low. But comparing the Monthly and Yearly total of 32 % with the same frequency of 4% for monochrome printers, the difference was

really large. This phenomenon indicated that although the environment for using color printers is available, monochrome printers are used instead, for the reasons of color printers' higher cost compared to monochrome printers, their slow printing speed, and color printouts were not necessary for actual business circumstances.

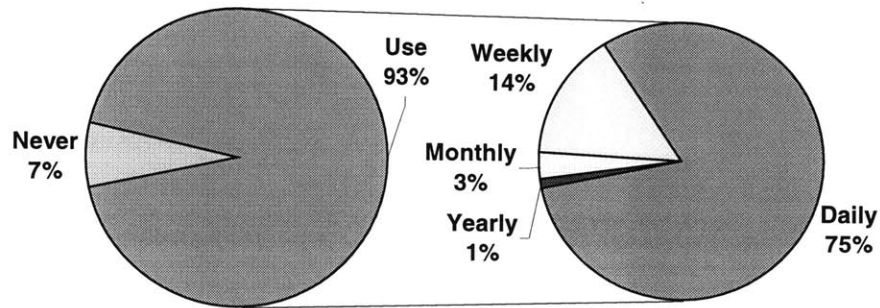


Chart 8: Networked B/W printer

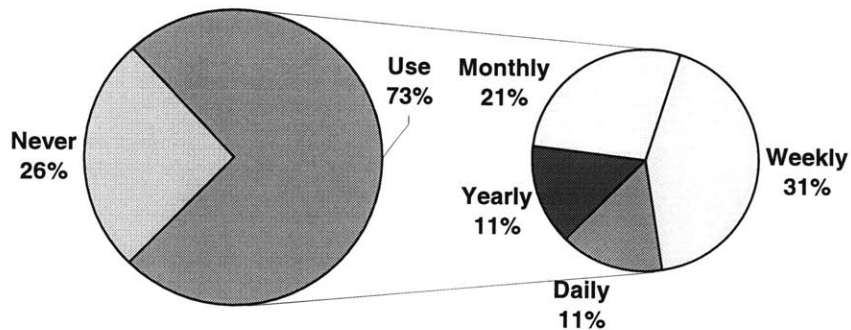


Chart 9: Networked color printer

Reasons to print electronic documents

- Q6-4: Why do you print electronic documents?

Reasons to print electronic documents were evaluated using four levels: 0:Not important, 1:Less important, 2:Important, and 3:Very important.

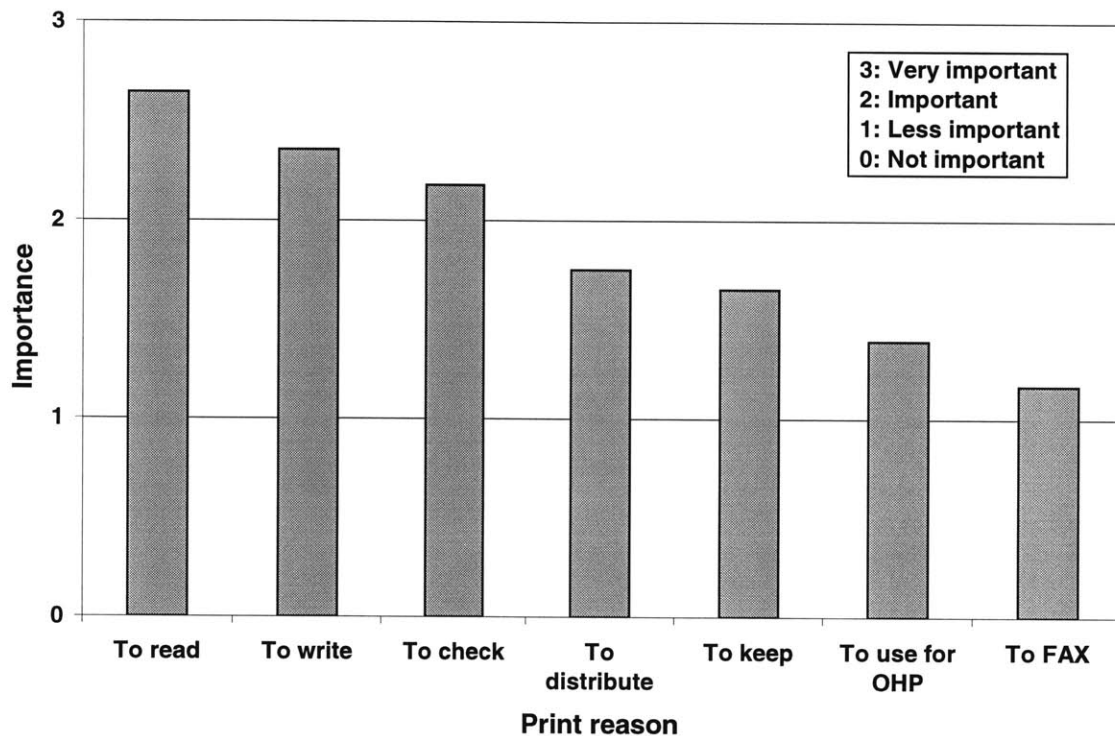


Chart 10: Reasons to print electronic documents

The print reasons with more than important level are: to read, to write and to check the contents. This result shows that printouts or paper documents have advantages over electronic documents because they are easy to read, easy to annotate, and easy to browse. In addition, about 10% answered under the category "Others" for portability. Although this item was not listed, some correspondents actually described it. Considering this fact, the importance of "portability" could have marked high if this item was included in the list.

The change of quantity of printing

- *Q6-5: How did the quantity that you printed change over the past 5-6 years?*

In this investigation, the change in the volume of business printout in the past 5 to 6 years was chosen from three categories: Decrease, Doesn't change, Increase.

The result shows that "increase" took almost half of the total, doubling "decrease." This actually reflected the current status of increased printing volume.

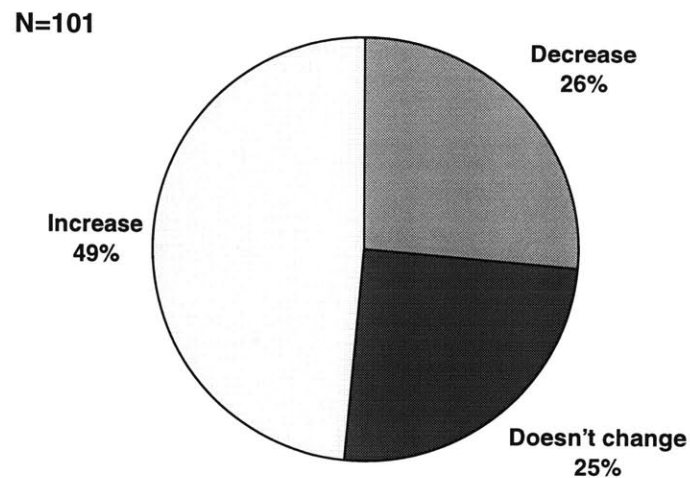


Chart 11: The quantity of printing over the past 5-6 years

Reasons for the change of quantity of printing

- *Q6-6: In your opinion, why did the change described in 6-5 occur?*

Correspondents were asked to indicate what they think are reasons for the change of quantity of printing. For Decrease, Increase, and Doesn't change given comments were listed by category.

Decrease

Spread of PC

- At work, each individual is provided with one machine
- Notebook PC enables reading of electronic documents anywhere

Spread of electronic documents

- Acclimate to using electronic documents
- Overwhelmingly increase of electronic documents as a result of company -wide internal electronic documents promotion
- Because of the Web, knowing the URL is enough to provide information
- A PC simplifies documents organization

Evolution of the display

- Larger size display is available
- Reading gets easier as displays' resolution gets higher

Cost reduction & Environment protection

- Just printing important documents, no more printing of unnecessary documents
- Because of the documents' massive number of pages, they get bulky and ink cost gets high, if a printout is needed
- There are many annoying people out there talking about environment issues
- Need to save papers

Others

- Remains as an evidence exposed to others' eyes
- There's a trend of decreasing individual space
- Time is limited for thorough reading, so be conscious about that capacity for printing volume as well
- No need to print color electronic documents in black and white

Increase

Absolute increase of electronic documents

- Amount of information has increased due to expansion of e-mail and Internet environment
- Spread of e-mail results in increased in circulating information
- Frequency of attachment in email by sender gets higher
- Amount of information is increased with networking
- Number of electronic documents I create gets higher
- Transition of created documents from paper to electronic form
- As the amount of information from the Web increases, there's still a tendency to store them on paper

Increase in number of electronic documents produced

- As the quality of documents get higher frequent printout is performed in order to check the layout, etc.
- It is easier to create and edit documents using PCs, test printouts are needed for checking contents and layout before the final print.

Higher Performance of printers

- Printers get faster
- There are more printers that can make clean print
- With 2 into 1 feature, double sided, color, and network functions, printers have become very convenient
- Making multiple printouts, instead of a single printout and copy it.
- Print process gets distributed as the number of network printers increases

Readability of paper

- Unless printout in the end, it's difficult to check the contents
- Paper has greater readability when it comes to thoroughly reading
- Reading on paper is much easier to go between pages
- It's easier to work on composition using paper
- Reading on the CRT gets me tired (especially with small Japanese characters)
- Documents containing extremely small fonts are received more often. Cannot even read unless I print them out

Portability of paper

- Freedom of reading anywhere including commuting time
- Small amount of documents is easy to carry around
- Paper doesn't restrict body position or location (such as smoking area) as much as monitors

Ease of write in

- The boss gives instruction by writing on paper
- Want to paste "post-it" write in

Circular information at meetings

- There is no other way than distributing by paper at meetings
- There is an increase in demand for printing out distribution documents for presentation
- Over Head Projector is still used at meetings

Request from the audience for paper distribution

- There are still people requesting paper instead of electronic media
- Increase in printing due to correspondence and an audience that cannot receive electronic documents
- Settlement is done by paper
- One of the reconfirming methods, in case the audience will not read the forwarded mail
- Seal/stamp is still needed for many occasions

Storage by paper

- Can be stored with related references
- It's reasonable to print when storing electronically, when the file to be saved contains many image files such as the Web pages

Personal reasons due to change in business activity

- Increase in receiving electronic documents
- Opportunity of creating and modifying important documents get increased
- Increase in business operations that require printouts
- As my eye sight gets weaker, I prefer reading on paper

Doesn't change

Offset between the increase of electronic documents and decrease in printing ratio

- Although the amount of electronic documents increases, viewing can be done using the display
- Although handling of the number of electronic documents increases, I select very carefully what to print

Others

- Because at Xerox, the electronic document creation environment by Star System and Xerox Network System base network print environment has been in place for a while, over all work style has not changed much, except the environment has migrated to a PC base.

In any correspondence, the recognition of increases in the total quantity of electronic documents reaches a consensus. In "Decrease," a majority of the correspondents indicate that with the spread of Notebook PCs and higher performing displays, most read/write activities are performed directly on the computer screen. Therefore, the quantity of printing has been decreasing despite of the increase in total volume of electronic documents.

On the other hand, in the "Increase" case, many people indicate that readability, portability and easy to annotate features of paper documents are much better than the features of electronic documents hardware restrictions such as display resolution. This results in increased of printing quantity as the total number of electronic documents increases. Because of advances in application functionality, documents created now have much higher quality. Consequently, with the increased use of smaller fonts and complicated layout, it has become extremely difficult to proofread on the computer screen. Therefore, many indicate an increase in proof printing during the document construction period. In addition, it has become easier to print, due to the availability of faster, higher quality and higher performing printers.

In summary;

1. Original documents migrate from paper to electronic documents.
2. Received electronic documents are printed out for reading and carrying.
3. During the construction of electronic documents, they are printed out for checking contents and layout on paper basis. Then revision is done on electronic documents.

In other words, paper documents are treated as short term, disposable, file on hand for corresponding electronic documents. In addition, a work style has involved where getting necessary printout has become popular. This phenomenon is accelerated by the availability of faster and higher performing printers.

Reasons to copy paper documents

- *Q7-1: Why do you copy paper documents?*

Reasons to copy paper documents were evaluated under following four levels: 0:Not important, 1:Less important, 2:Important, and 3:Very important.

The objectives of the top three important levels, "To distribute," "Have to return," and "Don't want to add changes" are different, however the action taken here involves duplicating the original paper document as is. It is predictable that these activities will be replaced with printing electronic documents, as the opportunity for creating electronic documents from the start will be increasing. And the fifth one, "Editing by copy" will be replaced by printing as printers add more higher functions such as enlargement/reduction, N into 1 feature, and double sided print.

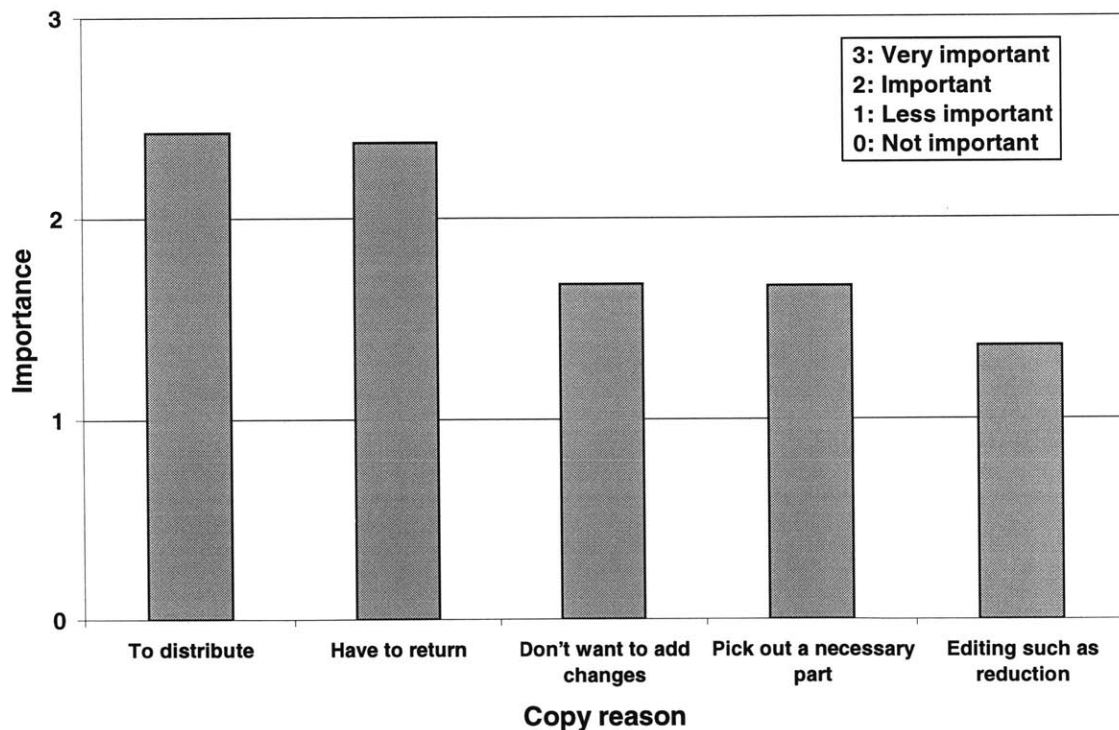


Chart 12: Reasons to copy paper documents

Frequency of capturing paper documents

- *Q7-2: What kind of paper documents do you capture in electronic documents?*

This investigation covered what kinds of paper documents are captured in electronic documents using scanners and computers.

The pie chart shows the frequency of capturing paper documents and there is no particular restriction on their contents. This reflects the highest frequency in answer to Question 7-2 as the correspondent's capturing frequency.

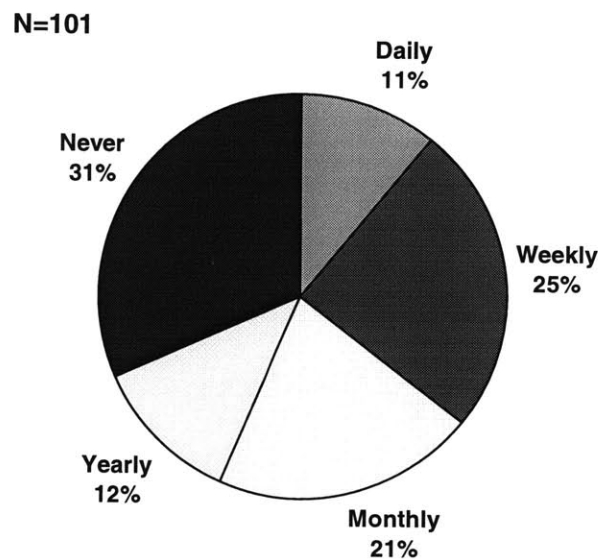


Chart 13: Frequency of capturing paper documents

The number of those who not do any capturing reached 30%. Again, even the ratio of correspondents doing capturing activities applied to mostly Weekly and Monthly. Therefore, the not so high frequency was confirmed. Images such as pictures and photos took the most and text of books and magazines followed for the kind of paper documents captured.

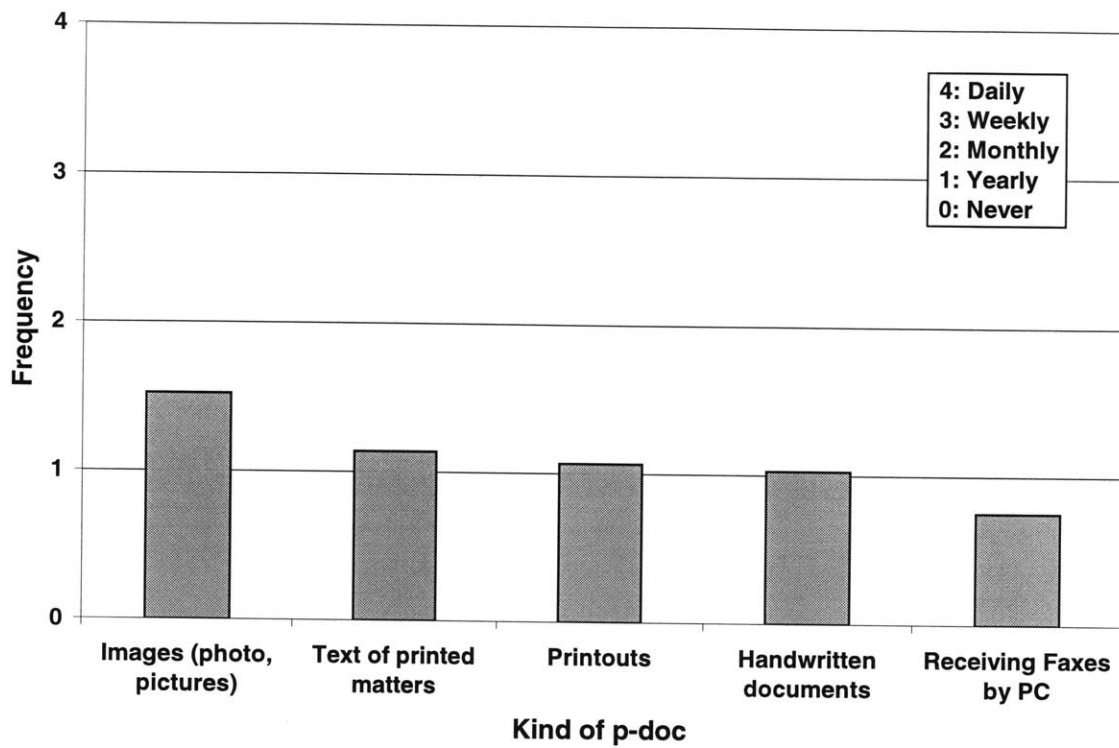


Chart 14: Kind of paper documents to capture in electronic documents

Reasons to capture/not capture paper documents

- *Q7-4: Why do you capture paper documents?*
- *Q7-5: When to choose not to capture electronic documents, why is that choice made?*

The next investigation covers the reasons for capturing and not capturing paper documents as electronic documents.

In the reasons for capturing, the importance of using the image for attachment, distribution, and storage exceeded the importance of post-capture editing such as character recognition.

In the reasons for not capturing, no possession of scanner, no need to capture, complicated post-capture work, and bad quality of the captured image were equally distributed. In addition, only a few correspondents indicated their lack of knowledge of how to use scanner. With these results, it's understood that the capture rate is very low in spite of availability of the capturing capability.

As the spread of Internet and evolution of image searching functions increases, it has become popular to search and to retrieve needed image documents from the network. In addition, taking digital photos directly has become equally popular as digital cameras gain higher performance while becoming lower in price. As these trends tend to accelerate, continued decrease of scanning paper image documents is predicted. Moreover, business-related documents will be created as electronic documents to begin with. In other words, in general, capture of paper documents as electronic documents will be decreasing.

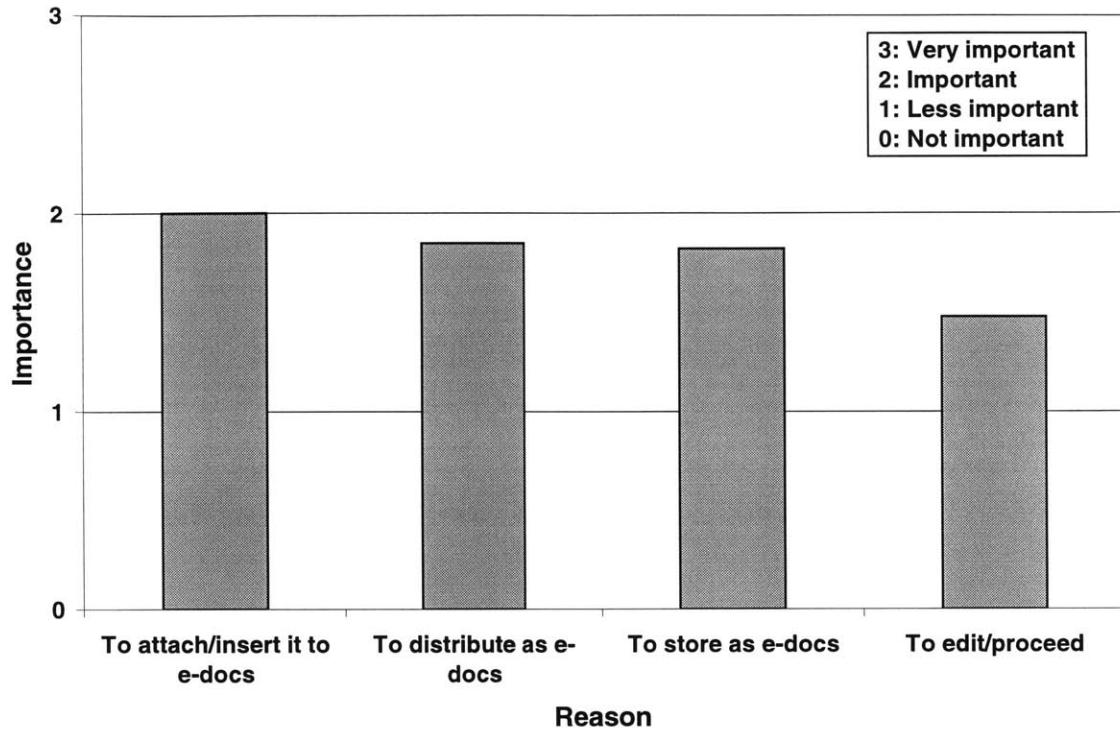


Chart 15: Reasons to capture paper documents

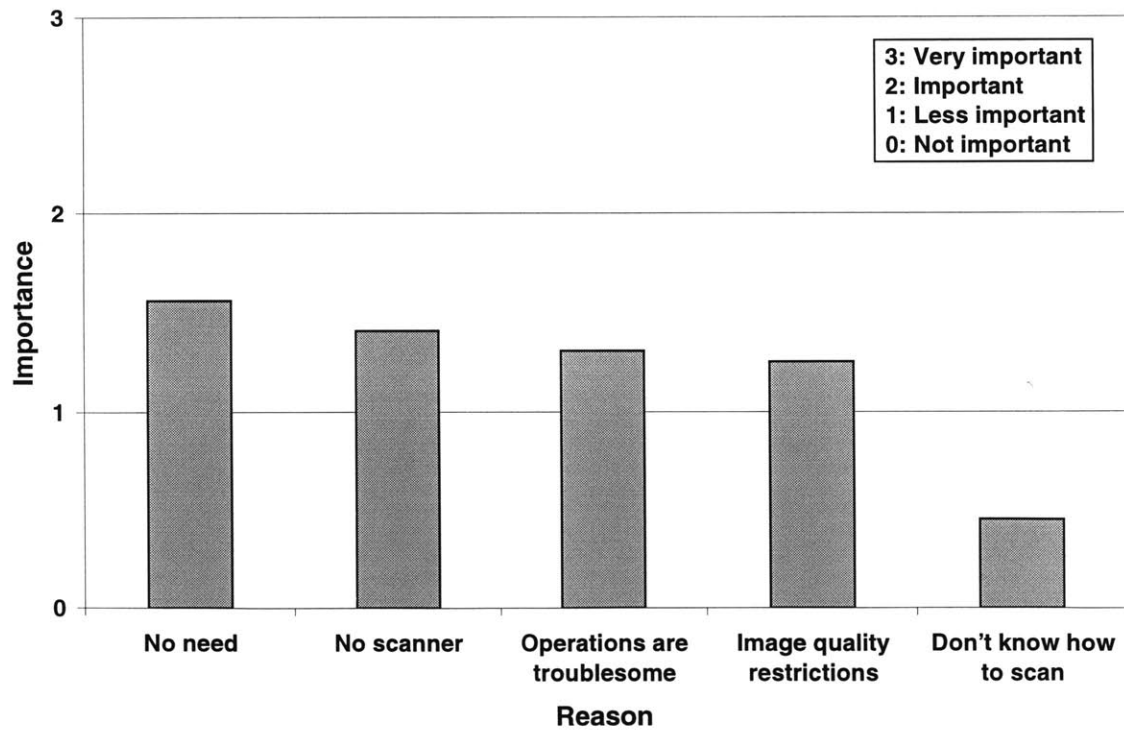


Chart 16: Reasons to not capture electronic documents

Methods to store/distribute electronic documents

- *Q8-1: How do you store electronic documents?*
- *Q8-3: How do you distribute electronic documents?*

This section of the survey covered the rate of paper document conversion when storing or distributing electronic documents.

The survey methods asked the percentage of each three cases for storage and distribution of electronic documents.

- Electronic documents only
- Both electronic documents & their printouts
- Printouts only

In the case of storage, the ratio of paper documents is only 10%, while electronic documents are stored at higher rates: 90%. Meanwhile, the rate of storing corresponding printout together with electronic documents is also relatively high at 25%.

On the other hand, in the case of distribution, printouts-only is 16%, about 1.5 times of the case of storage. However, distributing both paper and electronic documents is 11%, less than a half of the rate compared to storage. The result splits into two methods: paper only or electronic documents only.

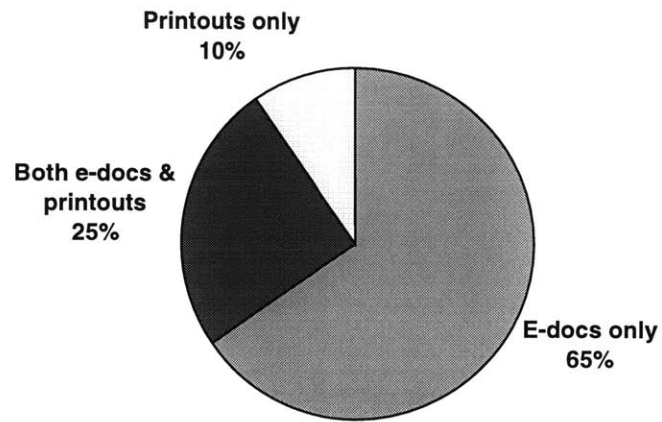


Chart 17: Methods to store electronic documents

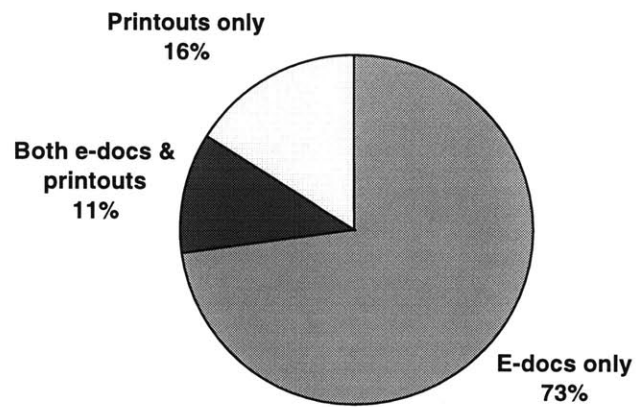


Chart 18: Methods to distribute electronic documents

Reasons to store printouts

- *Q8-2: Why do you store printouts of some electronic documents?*

This investigation covered the reason for converting electronic documents into paper documents for storage.

The most common answers showed the characteristics of paper media, such as readability, mixed storage in spite of different format or contents, and ease to find. Most of others involve preparing for failures such as a hard disk crash. In addition, combining this with preparing for loss of application. It is understood that storing of paper documents is as a back up for electronic documents.

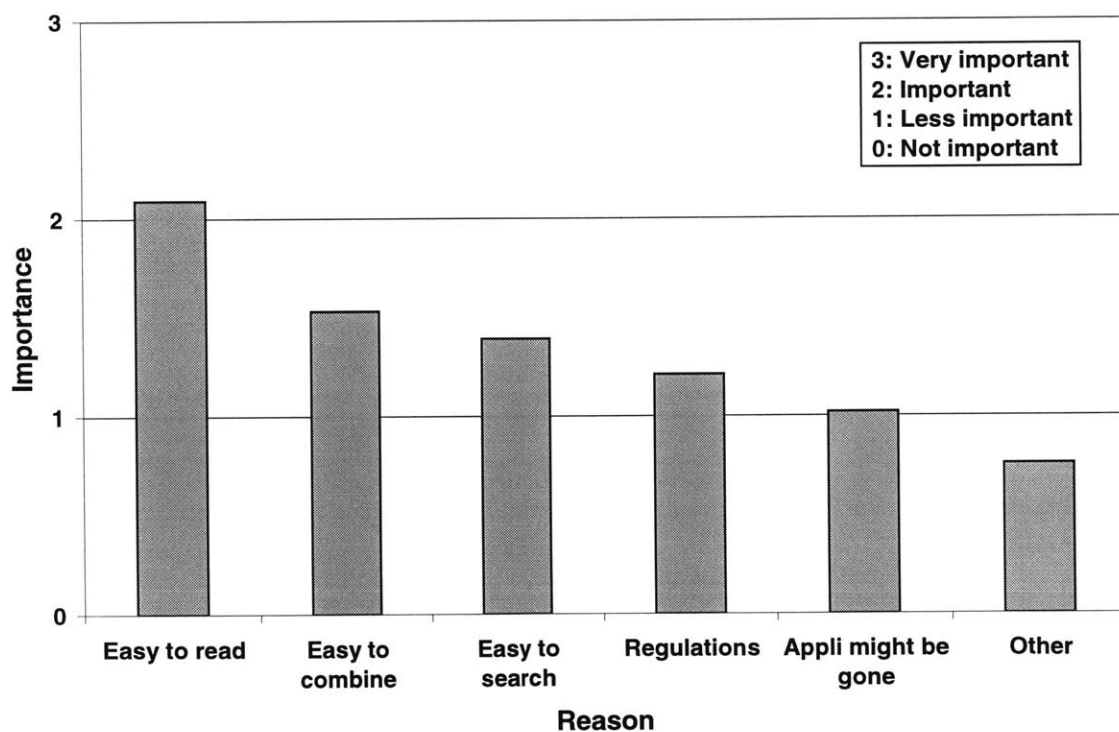


Chart 19: Reasons to store printouts of some electronic documents

Reasons to distribute printouts

- *Q8-4: Why do you distribute printouts of some electronic documents?*

The investigation covered the reason for converting electronic documents into paper documents for distribution.

Distributing as a handout at meetings explains the spike in the chart, reconfirming the other results, such as defectiveness of infrastructure as the lack of network capability and computers in meeting rooms, and the request from the audience for on site writing in.

The work style of regular distribution of electronic documents via e-mail and shared server, and distribution of printouts alone at the meeting reflect the similar bipolar result of electronic document and its printout, as described before.

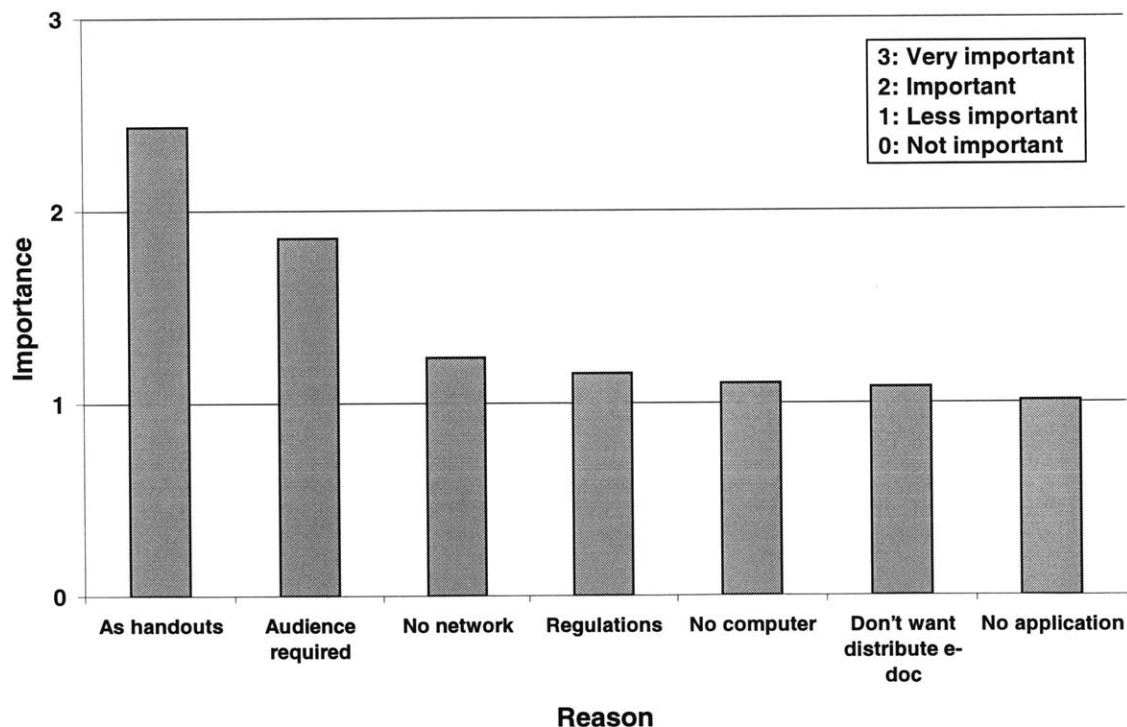


Chart 20: Reasons to distribute printouts of some electronic documents

The advantages of electronic documents

- *Q9-1: What do you think the advantages of electronic documents are?*

This survey covered the advantages of electronic documents. Four levels of evaluation; 0:Not important, 1:Less important, 2:Important, and 3:Very important, was given to each of 14 items. Within these items, 8 items which had more than "2:Important" were graphed. Almost all indicated that ease of distribution as "very important."

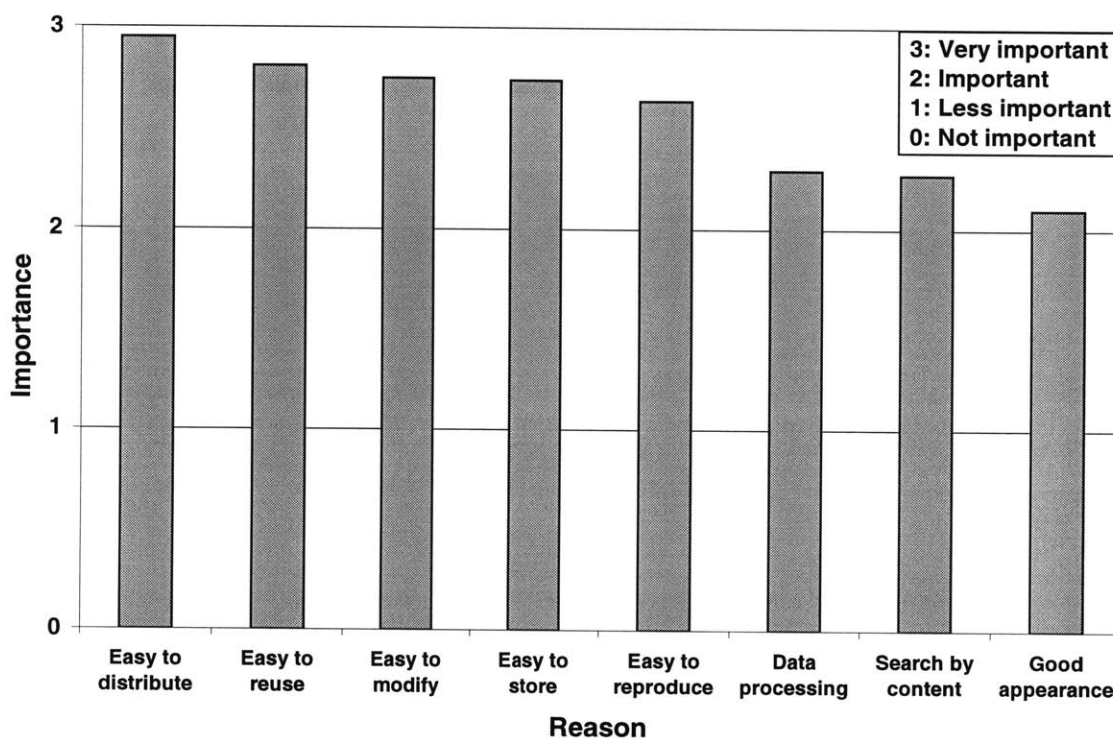


Chart 21: The advantages of electronic documents

Other than that, ease of reuse, duplication, process and edit became the top categories. These are all relative to paper documents. However, despite some of the characteristics of electronic documents that cannot be achieved by paper documents such as data processing, and full text search, the absolute evaluation was not as high as expected. Moreover, the ability to have accompanying information also shows a very low rate of 1.7 for attribution search such as by creation date, and 1.4 for attribution value record, compared to other reasons.

The disadvantages of electronic documents

- *Q9-2: What do you think the disadvantages of electronic documents are?*

This investigation covered the disadvantages of electronic documents.

As with the previous question, Four levels of evaluation were given to each of 12 items.

Within these items, 5 items which had more than "2:Important" were graphed.

The broad level results are:

1. Bad readability such as unable to view the whole thing, unable to browse, and difficult to read
2. Physical environmental restrictions such as in need of computers and applications

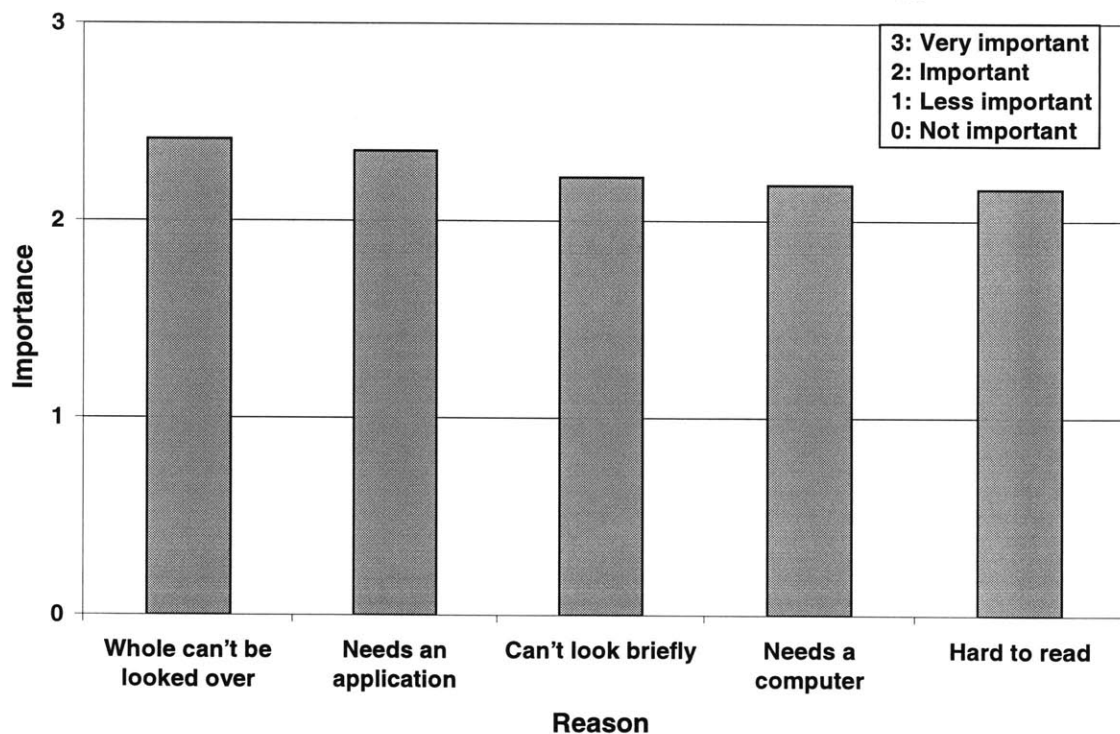


Chart 22: The disadvantages of electronic documents

The advantages of paper documents

- *Q9-3: What do you think the advantages of paper documents are?*

This investigation covered the advantages of paper documents.

Four levels of evaluation were given to each of 11 items. Within these items, 7 items which had more than "2:Important" were graphed. As a result, ease of reading, writing in, portability, and handling come together at the same importance level.

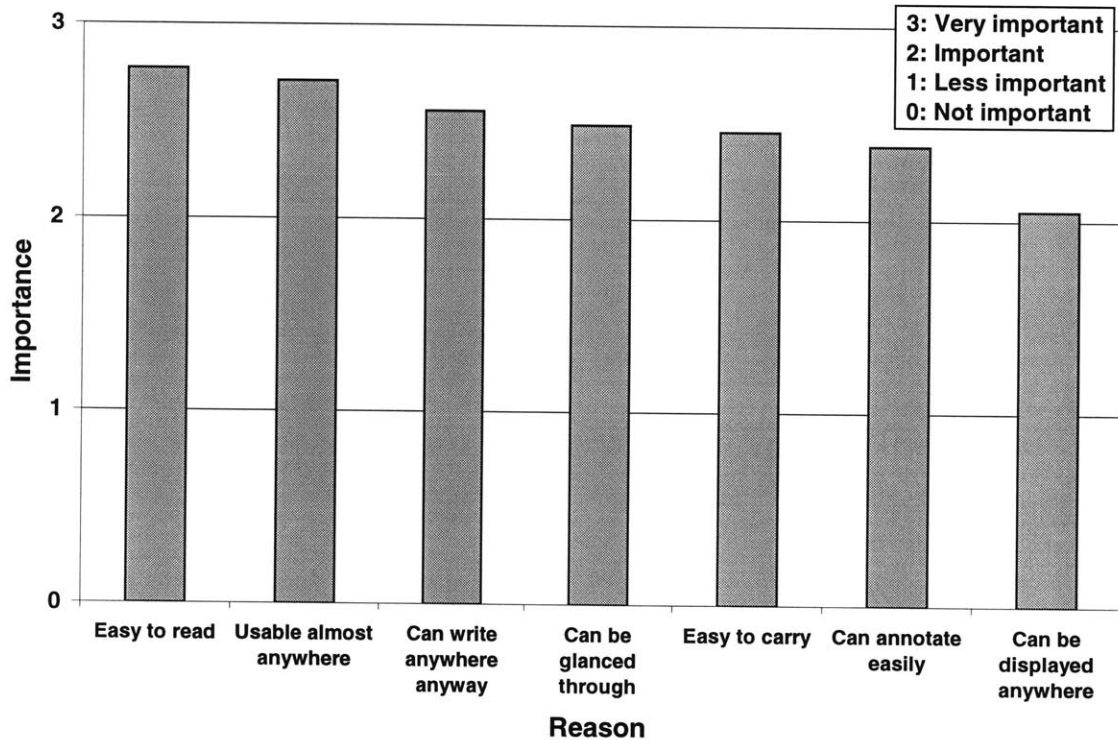


Chart 23: The advantages of paper documents

The disadvantages of paper documents

- Q9-4: *What do you think the disadvantages of paper documents are?*

This investigation covered the disadvantages of paper documents.

Four levels of evaluation were given to each of 8 items. Within these items, the top 7 items were graphed. Physical restriction of being bulky, difficult to organize, and difficult to distribute, and existing difficulties of utilizing the documents, such as difficult to reuse and edit come close to the same level. In addition, the protection of forest resources, a standpoint from environment issues, followed the pack.

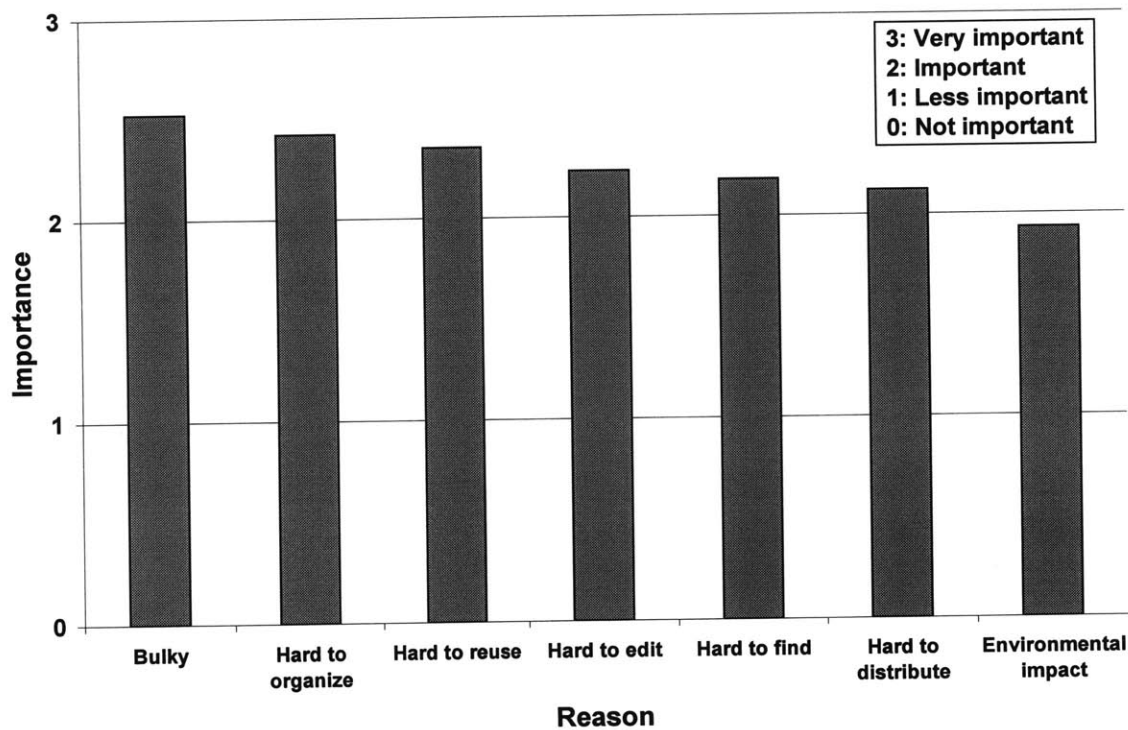


Chart 24: The disadvantages of paper documents

Requirement to increase the use of electronic documents

- Q9-5: *What will you think is necessary to increase the use of electronic documents?*

This section asked correspondents to describe freely what would be necessary in order to promote the further deployment of electronic documents in business.

The comments were divided into the following four different categories.

1. Evolution of input/output devices
2. Maintenance of the infrastructure
3. Promotion of reusability of electronic documents
4. Organizational support of application of electronic documents

1. Evolution of input/output devices

Thin and light mobile device

- Realization of browsing device having similar mobility as a paper
- Improvement of imaging quality and portability of mobile devices
- Paradigm shift of calculating devices such as Wearable Computer
- Light, thin and energy conserving computer
- Same levels of distributing characteristics as paper (portable enough to carry and hand out to the third party. Electronic media, possibly same low cost as paper)

Development of easy to view display media

- A screen easy to be viewed without fatiguing eyes
- High resolution and large size display
- Light and thin displaying devices

Development of easy to write input devices

- Unrestricted input to existing electronic documents
- Same level of editing/annotation capability as paper
- Development of innovative load reduction technology during input, such as voice input

Improvement in operability

- More ease of use in computer operation
- Tools for easier creation of documents

2. Maintenance of the infrastructure

Maintenance of computer use environment

- Larger capacity and faster process performance of personal computers
- Enable to deploy one computer per each user
- Growth of collaboration system such as electronic meetings

Maintenance of the network infrastructure

- Realization of a network environment that includes not only offices but also homes
- Maintenance of tools and high speed network (Enable sending color images)
- Development of Intranet accessible from anywhere (Network including mobile, while ensuring security)

Maintenance of input/output environment

- Spread of input devices (scanners, digital cameras, tablet, & electronic stylus)
- An environment that moves high speed printing possible if hard copy is needed

Improvement of reliability

- Fault tolerant personal computers, server and network
- A service providing accurate instruction immediately at the occurrence of software/hardware troubles

3. Promotion of reusability of electronic documents

Implementation of document database

- Newspaper and magazines to be published electronically; each article can be saved and searched individually
- Enable using a convenient database search system
- Higher performance of full text search

Distribution of document format

- Unification of standard document format
- Data compatibility among different platforms such as PC, Mac, and Unix
- Display function independent of applications/versions

Security and copy rights

- Security set up in document data
- Wide penetration and understanding of electronic copyrights such as copying, duplicating, editing, and processing

Transferring of paper document into electronic form

- Economical, easy electronic transfer of past data
- Improvement of reusability of data on paper information

4. Organizational support of application of electronic documents

Implementation of computer literacy

- Correction of paper biased orientation of management (especially office/clerical)
- Consciousness reform of top management (company wide implementation, etc)

Electronic authentication and settlement

- Realization of easy electronic account settlement
- Development of electronic certification technology
- Providing a business solution that can abolish voucher billings

Government's correspondence to electronic movement

- Maintenance of a public environment such as public offices and law
- Deregulation of law, electronic documents submission

Many answers indicated the improvement of usability of input/output devices, such as the development of thin and light mobile devices. Especially, the answer related to the development of easy to view display media reached 90% of the total. On the other hand, in contrast, those indicating the need for easy to write input devices stayed at around 20%. The image of the product might be something similar to an electronic notebook, which has same size and resolution as a paper, and has light and thin appearances.

Next, there were many infrastructure improvement related requests including deployment of computers for individual usage and access capability to high-speed networks from any location. In addition, over 10% of the correspondents stated the needs of the spread of input devices such as scanners, to retrieve paper documents easily into electronic documents, as well as the availability of high speed printers for quick output of electronic documents as paper documents.

Many answers not only provide the insight of creating new electronic documents but also provide the insight of promoting reuse of existing electronic documents. Establishment of a standard document format for data compatibility, security, and securing copyrights were indicated, in order to develop an integrated use environment that would include the company's internal document database as well as external databases. In contrast, less than 5% indicated the reuse of existing paper documents. This might be the tone of this question, which promotes the further transition to electronic documents for newly created documents.

Lastly, for organizational support of electronic documents applications, deployment of computer literacy to executives and management level, conversion of internal document and billing process electronically, and government's electronic transfer were indicated.

Necessary attributes information

- *Q10-1: What is the necessary information (attributes) about each document, independent from its content?*

This investigation covered necessary attributes information independent of document content.

Four levels of evaluation were given to each of 14 items. Within these items, 7 items which had more than "2:Important" were graphed. The top items were directly related to work activities such as the basic attribution of who creates/changes when, access control, and importance level. Other items resulted with "not necessary to be included."

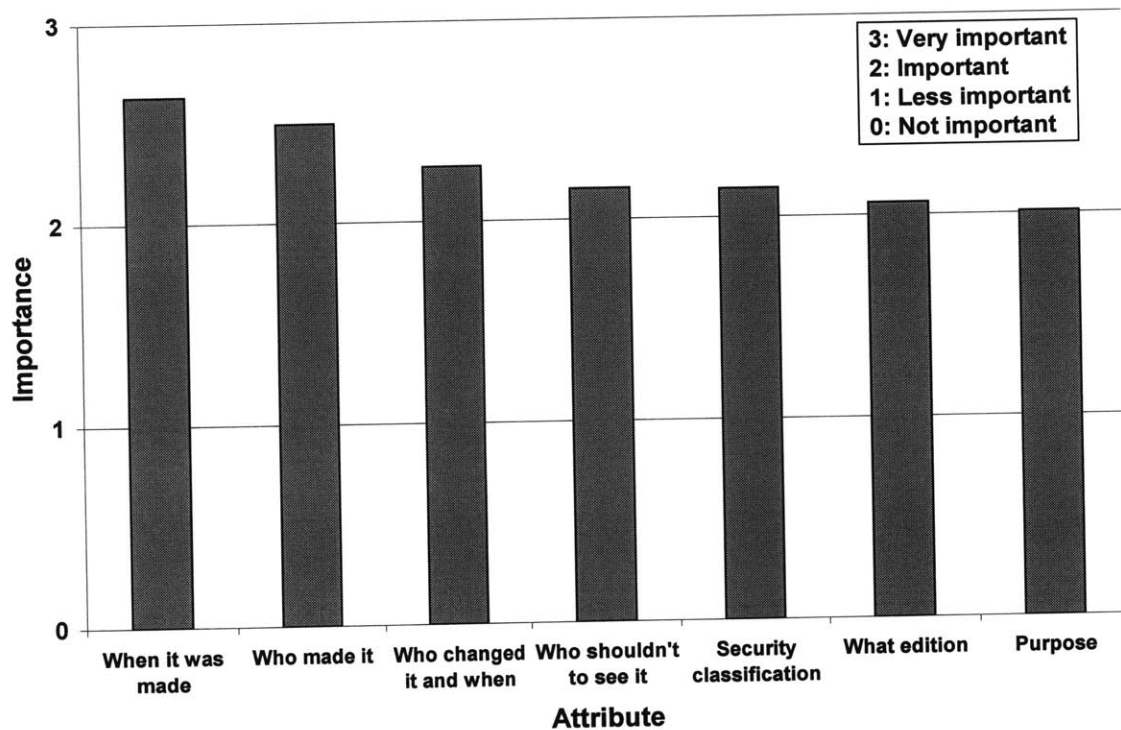


Chart 25: Necessary attributes information

This survey's result showed certain characteristics because the correspondents were mostly end users. However, different types of answers would be expected from document related business application groups like group-ware and workflow support sections. Therefore, a similar survey would be necessary for system design groups.

Document Lifecycle

Document as media

From the view point of basic media functions, which is the function of storing the information and distributing it, paper media like written books, since the invention of printing by Gutenberg, have been used effectively media for a long time. This brought a rapid improvement of information storage and distribution compared to previous methods of clay board and hand-written copy in terms of enabling accurate and easy large volume reproduction [McLuh1962, Sato1996].

However, the form of books and magazines is strictly a uniform and repetitious reproduction of information. Only publishers who have special equipment could produce it, the public didn't have a method of publishing information easily. Then later, thanks to the appearance of the typewriter, writing and printing functions became available for individual use. This created a concept of the business-related document. In addition, the invention of electro-photography copy technology by Xerox enables each individual to reproduce the information easily.

The important thing here is that Xerox technology enables not only simple document reproduction, but also creation of a huge number of new documents with original content and format by taking pages from several existing documents. Because of this, individual people are able to send documents with new information to larger numbers of people. Furthermore, regardless of the original media, like thick books, wide-size color magazines, or hand-written memos, copying allows them to be transferred into standard format of letter-size paper document. It can't be overemphasized that this improves document process operations, including filing dramatically.

Later, new media called electronic documents have been gaining popularity, thanks to the introduction of office automation tools, like word processors. Recent appearances of

high-speed, high-functionality, low-price hardware and rapid penetration of networking has caused a tremendous increase in volume of electronic documents in business. This results in a prediction that the amount of paper documentation will decrease dramatically, however, contrary to this prediction, the total number of paper documents has actually been increasing, since people tend to printout hardcopies of electronic documents.

One reason for this increase in paper documents is that people can get high quality printouts easily due to improvements in printer performance and color capability. However, from the human point of view, the characteristics of paper media surpass those of electronic documents, because they are easy to read, mobile, easy to handle, and easy to annotate. That is, paper is still the most flexible and user-friendly media.

Regarding the word, "media," Marshall McLuhan's word of 'media is a message' is well known. We usually think that message, namely information can be conveyed through media and media itself is a mere container of messages. Therefore, message is crucial and it is only a expedient as to which media is used to display and distribute it. It doesn't matter whether the same information is printed on paper or displayed on computer screen. However, as McLuhan pointed out, this observation is wrong and the type of media used for it affects on individual human body, independently from the contents that appear on it. In other words, each media has its own original message-like characteristic. No matter what kind of information is printed on a paper document, according to the characteristic of paper itself, it governs the pattern of a reader's feeling, his thinking pattern, and it may also have an effect on social structure [McLuh1960, McLuh1964, Ohsaw1995].

The result of this survey backs up the above argument on electronic documents and paper documents. Regardless of contents (a memo or a formal document) and format (e-mail or a spreadsheet) of electronic documents, people print paper documents based on the purpose of document usage such as careful reading, discussing with team members.

Paper documents vs. Electronic documents

The following table shows characteristics of paper documents and electronic documents as media.

Features	Paper Document	Electronic Document
Readability	<ul style="list-style-type: none">+ Easy to read+ Spread out on the table and can look at whole document+ Can do diagonally reading (Skim reading)	<ul style="list-style-type: none">- Hard to read, fatiguing eye- Limited to screen size- Can't skim+ High quality and good-looking
Portability	<ul style="list-style-type: none">+ Easy to take anywhere+ Read with any posture+ Put down anywhere (attach on the wall)	<ul style="list-style-type: none">- Need software and hardware to read- Restriction on place to read
Annotate-ability	<ul style="list-style-type: none">+ Freely add notes anywhere+ Easy to add annotation (post-it, etc.)	<ul style="list-style-type: none">- Limited space and method to add notes- Hard to add annotation
Visibility of Result	<ul style="list-style-type: none">+ Can see editing result as it's done+ Same appearance as contents	<ul style="list-style-type: none">- Gap between desire to do and its operation, operation and result- Gap between actual data and appearance
Openness	<ul style="list-style-type: none">+ Multiple people simultaneously read and write (different pages of large-sized paper spreading over the table)	<ul style="list-style-type: none">- Basically only one person can read and write at one time
Integrity	<ul style="list-style-type: none">+ Can compile in the same format regardless of contents and style	<ul style="list-style-type: none">- Requires different format or process depending upon used application type or version of it
Distribution Efficiency	<ul style="list-style-type: none">- More cost and time to distribute to distant area or large number of people	<ul style="list-style-type: none">+ Low cost and instantly to distribute to distant area, large number of people

Table 1: Paper documents vs. Electronic documents

Features	Paper Document	Electronic Document
<i>Searching Efficiency</i>	<ul style="list-style-type: none"> - Take more time and space to search in huge volume - Cumbersome to arrange and classify + With small volume, easier to search compared to electronic document 	<ul style="list-style-type: none"> + Easy to search in large-sized document using whole-documents search or parameter search function + Relatively easy to update file system
<i>Reusability</i>	<ul style="list-style-type: none"> - Hard to edit - Hard to keep original condition when to copy (lesser printing and paper quality by copy) - Cumbersome to transcript and make changes 	<ul style="list-style-type: none"> + Easy to edit + Able to have copy with the same quality as original + Easy to transcript or make changes only in necessary part
<i>Active Document</i>	<ul style="list-style-type: none"> + Guarantee contents consistency - No update of contents once it's developed - Out-of-date contents 	<ul style="list-style-type: none"> + Combining with data processing, easy to update to the latest contents automatically + Use support function like spell check
<i>Security</i>	<ul style="list-style-type: none"> + Physical proof with signature and stamp - Necessary to have physical security, like locker w/lock 	<ul style="list-style-type: none"> + Authentication by electronic signature + Easy security control with access control - Increase of hacker invasion through network
<i>Environmental Protection</i>	<ul style="list-style-type: none"> - Cut down trees - Consume energy when producing paper - Consume energy when printing out + Once it becomes paper document, no more use of energy 	<ul style="list-style-type: none"> - Consume energy when producing and using it (Energy protection view point, it's unknown by throughput level compared to paper document)

Table 2: Paper documents vs. Electronic documents (cont.)

Document Lifecycle

"A cradle to the graveyard" of documents, or the process of document construction to disposal, is called document lifecycle [MacLe1998, Xerox1998]. As an example, a model with six stages has been proposed [Unni1998]. These stages include construction, production, distribution, usage, archival, and disposal.

Based on the survey results and by expanding this model, this project gives consideration to how electronic documents and paper documents are differentiated in usage by users at each stage of the lifecycle as well as what the customer requirement is for each case.

Construction

Conception

This stage is an idea generation period. Through the act of making notes of ideas, internal thoughts are being acquired, processed, and settled. Instead of an act of creating documents, it is rather a thought process support using documents as a media, where documents created are either disposed or are limited to be used as draft in many cases.

Here, portability, annotate-ability, and visibility of result are very important requirements, and paper documents are often used. However, because of the spread of card type hypertext editors with advanced correcting functions, there are an increasing number of users creating electronic documents from the beginning, due to the ease of reusability of ideas.

Design

This stage is for considering logical structure of the document, such as clarifying themes and constructions of the story. Ease of editing is very important at this stage, as electronic documents are constructed from the ideas generated in paper documents. Support tools such as outline processors are often used.

Creation

This is a final stage of document construction, including the form of display layout of the contents. It is executed in electronic documents, while ease of editing and the quality of appearance are important.

However, readability, skim-ability, and visibility of result are very important, during the construction process of high quality documents [Norma1988]. For that reason, paper documents are converted from electronic form as proof prints. Then contents and layouts are reviewed, and notes are made. Based on the result of this procedure, a user then incorporates changes to the electronic documents manually. Then the proof print process will be repeated. Increased usage of high quality documents with complicated layouts and the spread of high-speed printers are promoting this trend. Paper documents created at this stage are for temporary use and will be disposed of within a short period [Bolte1991].

Production

Printing

This stage converts electronic documents into the format of paper documents for the purpose of careful reading, distribution, annotation, and storage. Different requirements, such as readability, portability, integrity, annotate-ability, and openness, are linked to each purpose.

Reproducing

Documents are reproduced for the purpose of reuse and distribution. Because of electronic documents' overwhelming advantage over paper documents in terms of reusability, normally, electronic documents retain the same format for reproduction. With the original paper document, copiers are used for reproduction. However, unlike in the case of electronic documents, it is difficult to create an exact reproduction of the original, due to inferiority in printing quality and differences in paper quality.

Sharing

Displaying

In face to face environment situations, such as meetings, the information is shared simultaneously by a number of personnel. While readability, portability, and openness are important [Harad1997], with the deficiency of infrastructure such as lack of computers and network in meeting rooms, paper documents are currently used. In addition, paper documents are distributed as handouts at presentations. This reflects that because of the characteristic advantages of annotate-ability, paper documents are very effective for fulfilling attendee's requests for making comments on documents on site.

Distribution

The objective is to communicate the information to numbers of personnel at remote locations. The electronic documents are used as is for the advantage of distributing the information to many audiences in remote location immediately at a low cost. For the forms of distribution, there are roughly two types; users reproduce electronic documents as needed from the shared electronic documents, using file servers and WWW servers, and the sender distributes electronic documents to audiences using e-mail. When the original is a paper document, physical mail and FAX are used. However, immediacy and cost issues gives physical mail disadvantages, while printout quality inferiority is the big restriction for the case of a FAX.

Usage

Searching and Retrieval

Electronic documents are used for the advantage of search efficiency. Especially the full-text-search feature is efficient since it does not require pre-categorization with keywords or items. In addition, organizing and categorizing of documents are possible, utilizing the file directory levels effectively. The change of categories on a later date is also important. Paper documents require organizing and categorizing at the time of storage. In addition, changes in categories at a later date require a tremendous amount of work. There is a flexible categorizing method in paper

documents such as using separate index card in libraries, however, the maintenance of the information on the card requires considerable effort.

Archival

From the aspect of reusability and search efficiency, archival takes the form of electronic documents. However, the rate of storage of paper documents still remains high, for its integrity of settling under unified format, in spite of content and form, regulations and customs, and as a back up for potential danger of systems crash.

Disposal

Although the consciousness of environmental protection has been rising in recent years, paper documents (with the presence of the original electronic documents) are disposed easily. On the other hand, regarding electronic documents, with higher capacity and lower cost of storage media, such as hard disks, even unnecessary electronic documents are stored just in case of any incidents.

Functional Flow Block Diagram for Document Lifecycle

The Functional Flow Block Diagram (FFBD) at Figure 1 shows the top-level functional behavior for the current/existing document lifecycle. An FFBD is a pictorial scheme used as a mechanism for portraying system design requirements, illustrating series and parallel relationships, and establishing a hierarchy of system functions [Boppe1998]. Each functional element in the diagram corresponds to a stage in the document lifecycle and the diagram reflects the functional behavior based on the analysis of the survey results. The behavior is divided into two different phases: a construction phase and a usage phase.

The construction phase is from conception to sharing and archiving. In this phase, usually the same person is involved in each function for a relatively short period such as a day or a week. The lower level decomposed diagram for the construction phase can be seen in Figure 2. "E-Doc" and "P-Doc" stand for an electronic document and a paper document respectively. Each group of lower level functions, which is enclosed with a rectangle with broken-lined sides, corresponds to its respective top-level function at Figure 1. Each decomposed function represents the sub-stage at the document lifecycle such as conception, design, and creation, which are discussed in the "Document Lifecycle" section.

The usage phase is from usage and reproduction to construction, sharing, archive, and disposal. In this phase, several different people are involved with each function in parallel at various periods such as a week or a year. The lower level decomposed diagram for the usage phase is shown in Figure 3.

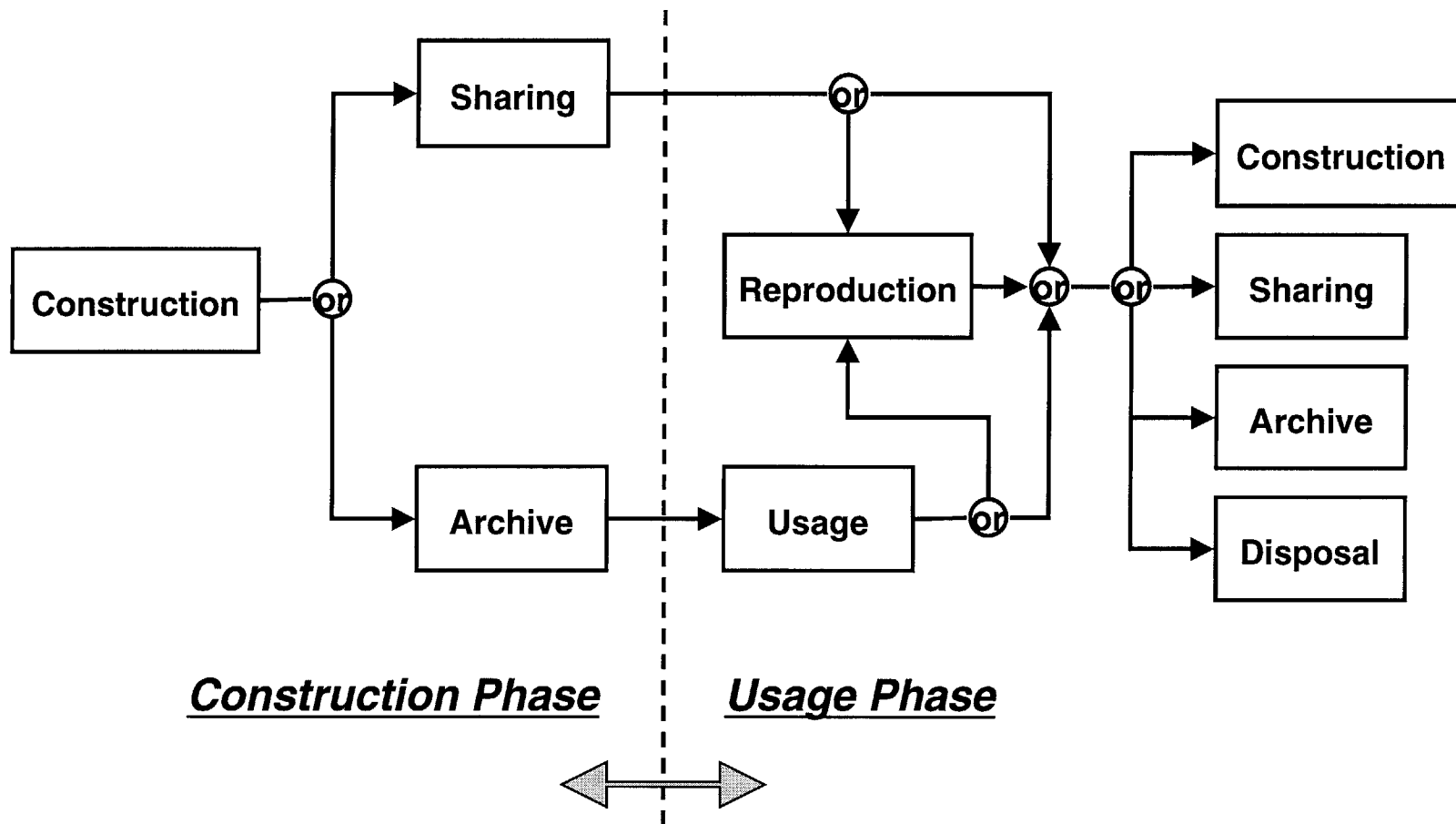


Figure 1: FFBD for Document Lifecycle - Top level

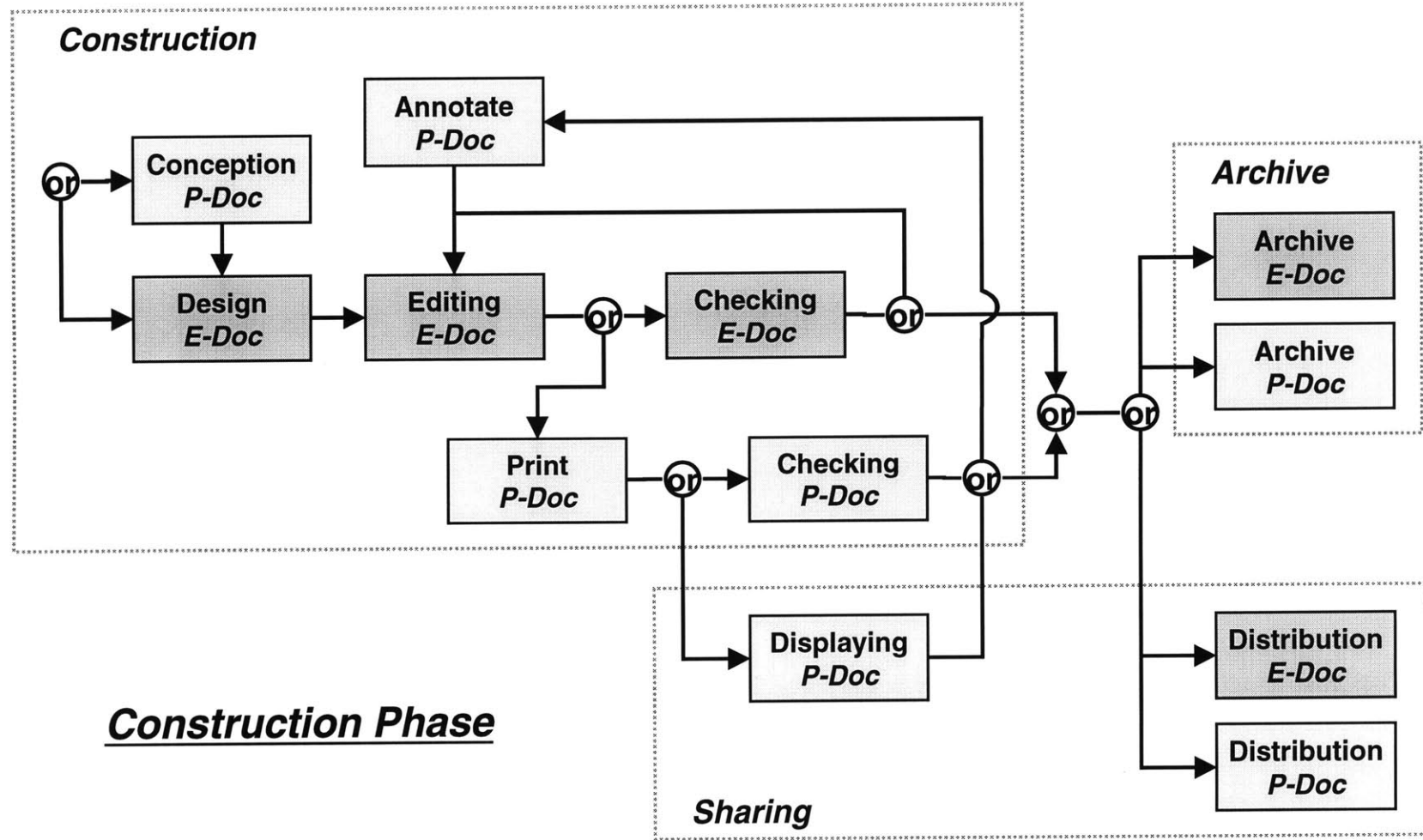


Figure 2: FFBD for Document Lifecycle - Construction Phase

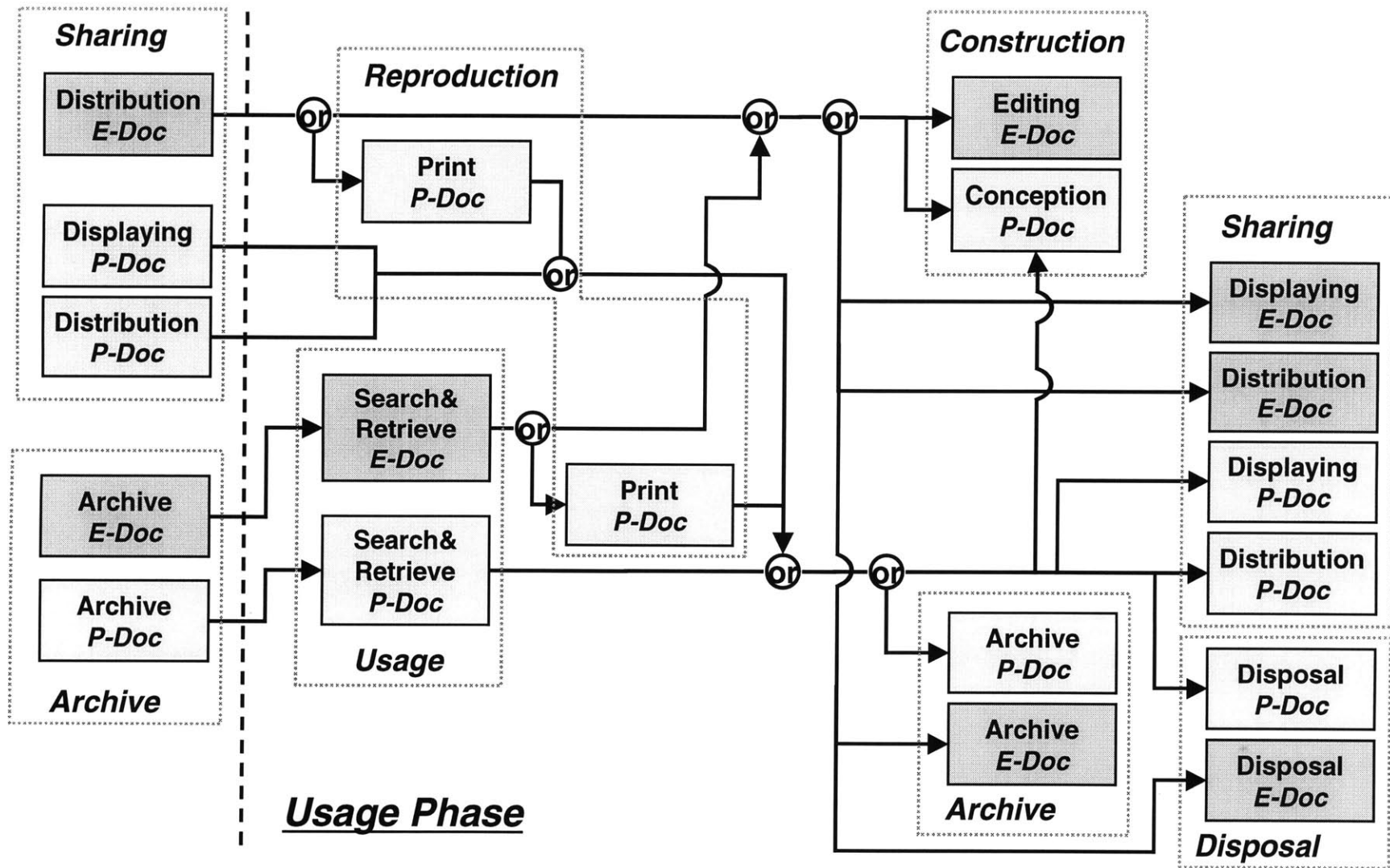


Figure 3: FFBD for Document Lifecycle - Usage Phase

New Document Lifecycle Concepts

In order to develop the important technical requirements for an ideal document lifecycle, a *Quality Function Deployment (QFD) Matrix* was conducted. The goal of the first level *QFD Matrix*, such as the *QFD Requirements Matrix* (also called '*House of Quality*'), is to tie customer needs to technical design requirements [Boppe1998, Ulric1995].

Selecting Customer Requirements

In order to develop the important customer requirements in the entire document lifecycle, a weighted scale method was used. Each need was weighted on a scale of zero to three (higher weights are more important than lower ones) for each stage of the document lifecycle, and requirements are ranked by their sum total score.

The result is shown in Table 3. The requirements with a total score of six or more are discussed after this, since they have the highest scores at least at two stages of the document lifecycle or they have scores at least at three stages of the document lifecycle. There are twelve selected requirements: "easy to read," "easy to reproduce," "easy to reuse," "easy to annotate," "easy to carry," "easy to modify," "can be glanced through," "usable almost anywhere," "can write anywhere anyway," "easy to distribute," "easy to search," and "good appearance."

Conception	Design	Creation	Reproducing	Displaying	Distribution	Usage	Archival	Disposal	Total	Customer Needs
2	3	3		3		3			14	Easy to read
			3		3		3	2	11	Easy to reproduce
	3	3				3			9	Easy to reuse
2	2			3		2			9	Easy to annotate
2				3	1	3			9	Easy to carry
1	3	3		1					8	Easy to modify
2	1			3		2			8	Can be glanced through
2				2		3			7	Usable almost anywhere
3	1			2					6	Can write anywhere anyway
					3	3			6	Easy to distribute
						3	3		6	Easy to search
		3				3			6	Good appearance
					2	3			5	Easy to retrieve
		2				3			5	Can be data processing
1				3					4	Can be displayed anywhere
							3		3	Easy to store
							3		3	Easy to backup
							3		3	Easy to classified

Table 3: Customer needs selection

QFD Requirements Matrix

Customer needs were weighted on the same scale as the total score in the previous section. In this case, the scale is from 6 to 14. The higher weight requirement is much more important than the lower weight requirement. Table 4 shows a QFD Requirements Matrix for the twelve-selected customer needs.

Across the top of the matrix is a list of technical design requirements that were selected as being sufficient to fulfill the customer requirements. The matrix is filled with estimates of how the technical need in the column interacts with the customer requirement listed in the row. Four levels of interactions were used in the table. Nine, three, one, and blank correspond to strong, medium, weak, and no interaction, respectively.

On the bottom of the table, the relative importance of each technical requirement is calculated by summing the product of the customer requirement weight and the interaction strengths for all of the customer requirements.

It is essential when doing QFD that there not be large holes in the matrix, such as customer needs that don't have corresponding technical design requirements, or technical design requirements that don't have corresponding customer needs. The latter are requirement candidates for immediate elimination, the former need requirements developed to cover these needs if they are indeed a priority [Boppe1998].

Customer Needs	Technical Design Requirement																											
	Weight for each need	Eye-friendly visualization	Wide visualize area	Efficient visualize capability	Efficient reproduction	Inferior-free reproduction	Reusable document format	Original document information	Efficient reuse capability	Efficient annotate capability	Content-free annotation	Equipment independence	Portable equipment	Durable feature	Equip infrastructure	User interface transparency	Efficient edit capability	Undo/cancel modification	Browse/rifle capability	Position free user interface	Layout free edit capability	Multiple address distribution	Distance free distribution	Immediately distribution	Context search	Attribute search	High quality appearance	
	Easy to read	14	9	9	9														1	1							1	
	Easy to reproduce	11				9	9	1	3																			
	Easy to reuse	9				1	1	9	9	9																		
	Easy to annotate	9	3	1	1				1		9	9					1		3			1						
	Easy to carry	9										9	9	9	9					3								
	Easy to modify	8	3		1				1			1					9	9	9	1		3						
	Can be glanced through	8	3	3	3															9								
	Usable almost anywhere	7											3	3	3	1					9							
	Can write anywhere anyway	6															1	1				9						
	Easy to distribute	6				1																	9	9	9			
	Easy to search	6	1	1	1				1											3						9	9	
Good appearance	6					1																				9		
Total scores			207	165	173	114	114	92	137	81	81	89	102	102	102	88	87	78	99	112	104	87	54	54	54	54	68	
Order			1	3	2	5	5	13	4	18	18	14	9	9	9	15	16	20	12	7	8	16	22	22	22	22	21	

Table 4: QFD Requirements Matrix (Relationship Matrix)

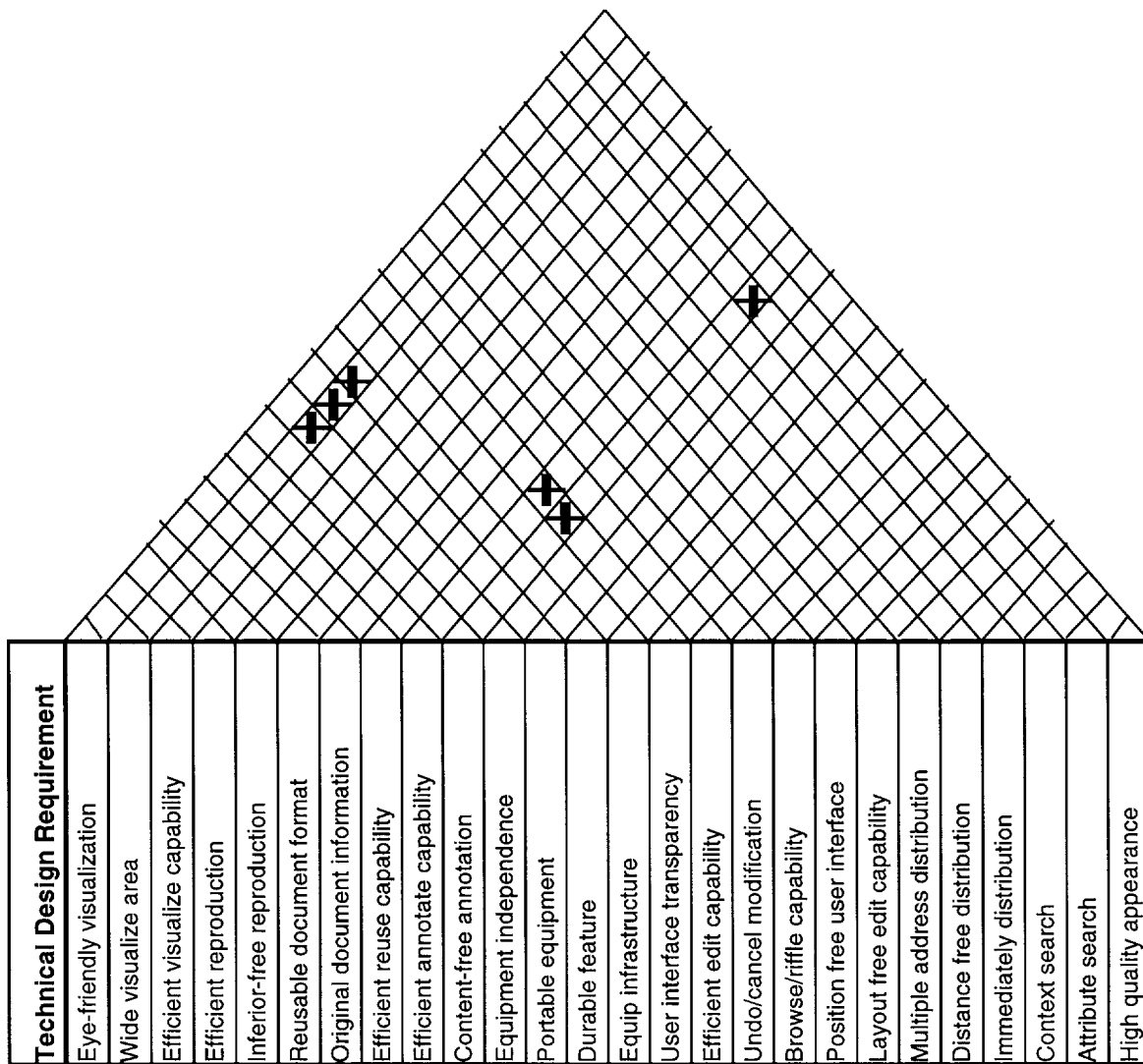


Table 5: QFD Requirements Matrix (Correlation Matrix)

Table 5 shows a QFD Correlation Matrix for technical requirements. The matrix shows the strong negative relations that identify adverse effects on solving customer needs.

For example, the requirement for "wide visualize area" conflicts with the requirements to:

- Implement "equipment independence"
- Implement "portable equipment"
- Implement "durable feature"

Technical Requirements Results

The three most important technical design requirements are "eye-friendly visualization," "efficient visualize capability," and "wide visualize area." All of the three requirements are related to the viewing features. This is an expected result for the given customer requirements, such as "easy to read," "can be glanced through," and "easy to search."

The top fourteen technical requirements results were divided into the following four different categories.

1. Readability
2. Portability
3. Reproducibility
4. Reusability

The requirements are ranked by their score. The top fourteen requirements are discussed below in each category that the requirement belongs. Any deviation in one of these requirements will have a strong impact on the ability to meet the customer needs.

1. Readability

There are four technical design requirements that have strong relationships with the need to "easy to read," and medium or weak relationships with the needs to "easy to annotate," "can be glanced through," and "easy to search."

- Eye-friendly visualization (207 points)
- Efficient visualize capability (173 points)
- Wide visualize area (165 points)
- Browse/riffle capability (112 points)

2. *Portability*

There are four technical design requirements that have strong relationships with the need to "easy to carry," and medium or weak relationships with the needs to "usable almost anywhere."

- Position free User Interface (104 points)
- Equipment independence (102 points)
- Portable equipment (102 points)
- Durable feature (102 points)

3. *Reproducibility*

There are four technical design requirements that have relationships with the need to "easy to reproduce," and "easy to reuse."

- Original document information (137 points)
- Efficient reproduction (114 points)
- Inferior-free reproduction (114 points)
- Reusable document format (92 points)

4. *Reusability*

There are two technical design requirements that have relationships with the need to "easy to modify," and "easy to annotate."

- Undo/cancel modification (99 points)
- Content-free annotation (89 points)

QFD Product Design Matrix

Next, in order to develop the system design part characteristics, a *QFD Product Design Matrix* was used. The goal of a QFD Product Design Matrix is to tie technical design requirements to design part characteristics. Table 6 shows a QFD Product Design Matrix for the fourteen selected technical design requirements.

Technical design requirements were weighted on the score, which is the quotient of the total score in the QFD Requirements Matrix divided by 20. In this case, the scale is from 4 to 10. The higher scaled requirement is more important than the lower scaled requirement.

Just like the QFD Requirements Matrix, across the top of the matrix is a list of design part characteristics that were selected as being sufficient to fulfill the technical design requirements. The same four levels of interactions and calculation methods were used in the table.

The list of design part characteristics is composed of two different categories, which are the design part characteristics for the electronic document and the design part characteristics for the paper document. There are thirty and thirteen design part characteristics for the electronic document and the paper document, respectively.

Technical Design Requirements	Design Part Characteristics	Electronic Document																										Paper Document																
		Weight for each requirements (1/20)																																										
Eye-friendly visualization	10	9	9	1		3																							9	9		3				9	9							
Efficient visualize capability	9	3	3	9	9	1					1	1			1															9	9	9	9	9	9	9	9	9	9	9	9			
Wide visualize area	8	3		3		9																									1			9	9	9		9	9	9	9			
Original document information	7						9	9		1																				9	3			9	9	9		9	9	9	9			
Efficient reproduction	6						1	1	9	9																		3	1	9	9	9	9	9	9	9	9	9	9	9	9	9		
Inferior-free reproduction	6						1	1	9	9																				9	9		3	3	3	9	9	9		9	9	9		
Browse/riffle capability	6	3	1	3	3	3					9	9																		9	9		3	9	9		9	9		3	9	9		
Position free User Interface	5												9	9	9	9	1			1	1	1	1	1					9															
Equipment independence	5															9	9	9																		3								
Durable feature	5																		9	9											3					3								
Portable equipment	5												3	3	1	1	3	3	3	3	3	9	9	9	9	9				3	3	3	3	1	9	9	3				1	9	9	
Undo/cancel modification	5						3	3	3																		9	9							3									
Reusable document format	5																											9	9	1														
Content-free annotation	4						1	1	3	1			1														3	3		9	3					9								
Total scores		159	123	133	99	129	94	94	135	119	63	63	64	60	50	59	65	60	60	65	65	50	50	50	45	45	57	57	85	45	68	491	369	150	245	291	291	267	404	354	135	231	277	277
Total order		12	18	16	20	17	21	21	14	19	29	29	28	31	37	34	25	31	31	25	25	37	37	37	41	41	35	35	23	41	24	1	3	13	10	5	5	9	2	4	14	11	7	7
Order in each doc type		1	5	3	7	4	8	8	2	6	16	16	15	18	24	21	12	18	18	12	12	24	24	24	28	28	22	22	10	28	11	1	3	12	10	5	5	9	2	4	13	11	7	7

Table 6: QFD Product Design Matrix

Defects of Current Document Lifecycle

As described above, The top fourteen technical requirements results for the document lifecycle were divided into the following four different categories: readability, portability, reproducibility, and reusability. Paper documents satisfy only the first two categories, such as readability and portability, and electronic documents satisfy the last two categories, such as reproducibility and reusability. Therefore, users have to choose appropriate document type at each stage of lifecycle to satisfy different user needs. In the current document lifecycle, electronic documents and paper documents are not cooperating. Once a user prints a paper document from an electronic document, there is no relationship information between the paper document and the electronic document. That is, the user must remember the relationship information if the user wants to access the corresponding electronic documents and/or the paper documents later.

To solve this defect, two different new document lifecycle design concepts are proposed. They are the mobile electronic document concept and the integrated electronic/paper document concept. The first concept focuses on developing an advanced mobile device that allows users to implement more user-friendly electronic document processing. The second concept focuses on the cooperative usage of electronic documents and paper documents, and this document processing architecture enables users freely to choose the types of documentation media they use, in response to needs.

Design Concept 1- Mobile Electronic Document

The first design concept involves developing a mobile electronic document that satisfies the technical design requirements. Table 7 shows a QFD Product Design Matrix with the selected design part characteristics for this concept. The image of the product is a combination of an electronic document and an electronic notebook, which enables not only reproducibility and reusability but also readability and portability. Users can read, write, annotate, and browse electronic documents efficiently without printing paper documents, also users can carry the device easily.

Figures 4 and 5 show a FFBD for a mobile electronic document concept. Comparing to the original FFBD in Figure 2 and 3, the concept can eliminate some paper document utilization, such as “Checking P-Doc,” “Annotate P-Doc,” and “Distribution P-Doc.”

Actually, many mobile computing devices, such as palm computers, are being developed to realize this concept. However, they do not satisfy the user needs so far, with hardware and/or software restrictions such as low-resolution monitor and non-intuitive user interface. Paper will still be the most flexible and user-friendly media for a while. Moreover, this concept is not compatible with existing documents and facilities, and it might be costly.

			E-Doc																									
Technical Design Requirements	Design Part Characteristics	Weight for each requirements (1/20)	High resolution monitor	Less flicker monitor	Display zooming function	Fast viewing	Wide size monitor	Document identifier (Did)	Document identifier manager	Document content reproduction	Document attributes reproduction	Fast leaf throughing function	Thumb nail function	Pen input	Wide visual angle display	Mobile computing device	Telecommunication feature	Robust material	Shock-resistant design	Light weight materials	Thin external form	Energy-saving design	Long-life battery	Modify history	Undo/redo function	Portable document format	Separate annotation information	
	Eye-friendly visualization	10	9	9	1		3																					
	Efficient visualize capability	9	3	3	9	9	1					1	1		1													
	Wide visualize area	8	3		3		9																					
	Original document information	7						9	9		1																	
	Efficient reproduction	6						1	1	9	9															3	1	
	Inferior-free reproduction	6						1	1	9	9															3	1	
	Browse/riffle capability	6	3	1	3	3	3						9	9														
	Position free User Interface	5													9	9	1		1	1	1							
	Equipment independence	5															9	9										
	Durable feature	5																	9	9								
	Portable equipment	5													3	1	3	3	3	3	9	9	9	9				
	Undo/cancel modification	5						3	3	3														9	9		3	
	Reusable document format	5																								9	1	
	Content-free annotation	4						1	1	3	1				1									3	3	1	9	
	Total scores			159	123	133	99	129	94	94	135	119	63	63	64	59	65	60	65	65	50	50	45	45	57	57	85	68
	Total order			13	18	16	20	17	21	21	14	19	29	29	28	34	25	31	25	25	37	37	41	41	35	35	23	24
Order in each doc type			1	5	3	7	4	8	8	2	6	16	16	15	21	12	18	12	12	24	24	28	28	22	22	10	11	

Table 7: QFD Product Design Matrix - Mobile Electronic Document

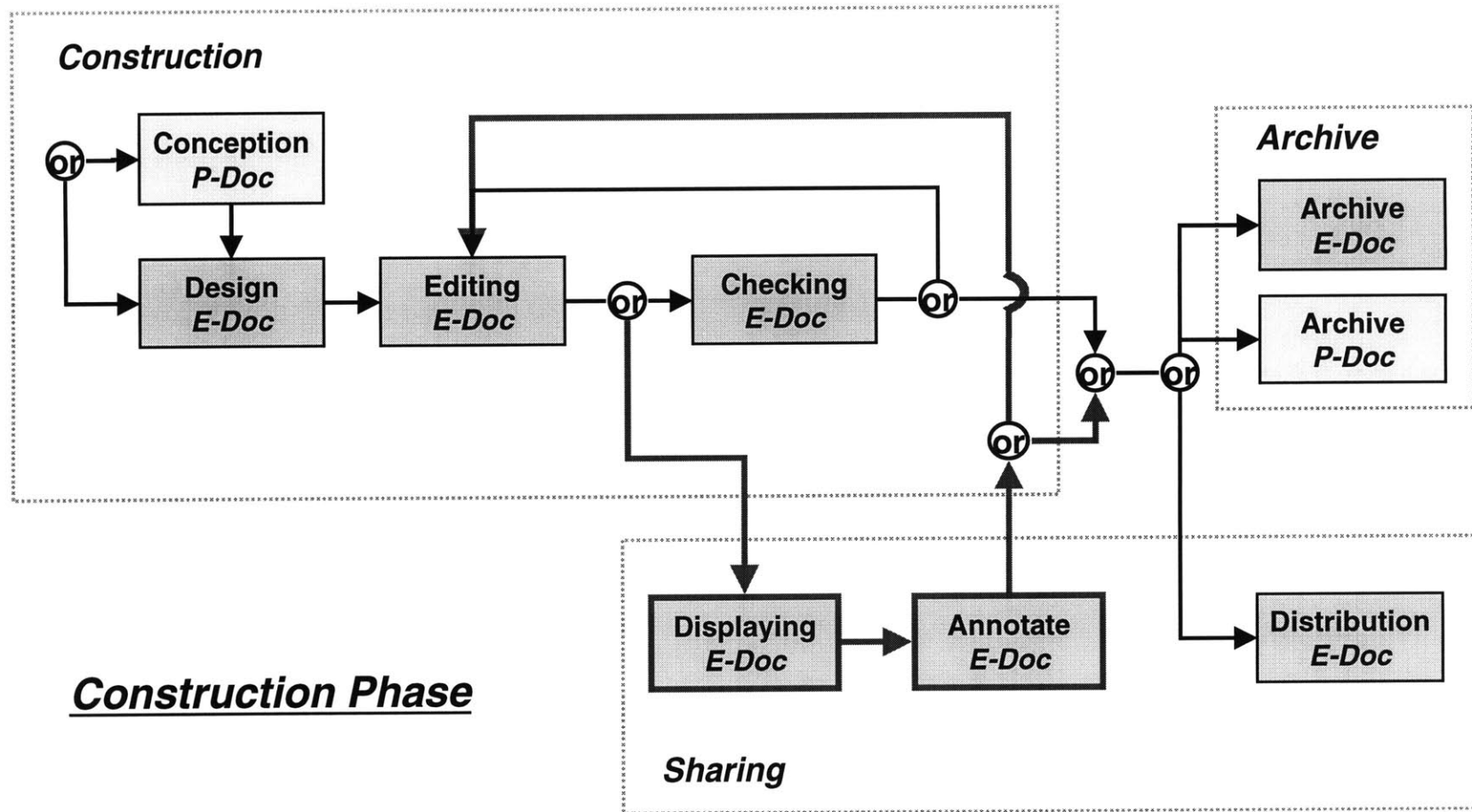


Figure 4: FFBD for Mobile Electronic Document

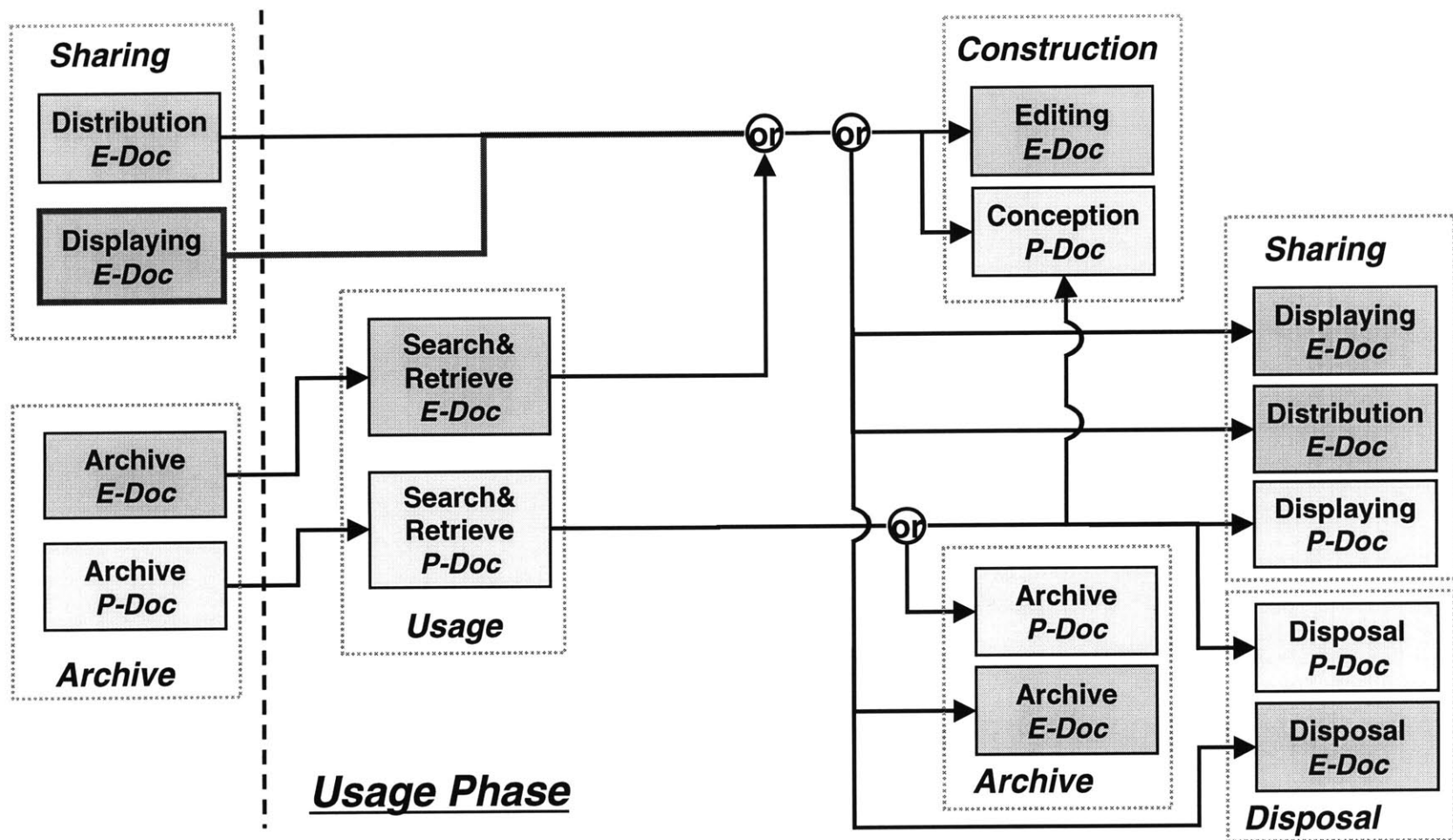


Figure 5: FFBD for Mobile Electronic Document (cont.)

Design Concept 2 - Integrated Electronic/Paper Document

The second design concept is based on an integrated electronic/paper document. Table 8 shows a QFD Product Design Matrix with the selecting design part characteristics for this concept. The main idea of the concept involves embedding a document identifier (Did) in a paper document, which enables users to access the corresponding original electronic document. Bar codes, invisible ink, and media watermarks are considered to the candidate Did representations.

With the embedded Did, after a user prints a paper document from an electronic document, there is still relationship information between the paper document and the electronic document. That is to say, users do not have to remember the information of the corresponding original electronic documents and they can easily access to it. Therefore, the concept enables users freely to choose the type of documentation media they use, in response to their needs.

Figures 6 and 7 show a FFBD for an integrated electronic/paper document concept. Comparing with the original FFBD in Figure 2 and 3, the concept allows users to transfer between paper documents and electronic documents by using “P-Doc to E-Doc” and “E-Doc to P-Doc” functions. Even if users only have a paper document, they can access the corresponding electronic document in order to enjoy the features which are only provided by electronic documents, such as easy to distribute, easy to reuse, and easy to modify, etc.

Figures 8 and 9 show the current document lifecycle and the proposed document lifecycle that would exist using the integrated electronic/paper document concept.

		E-Doc								P-Doc													
		Design Part Characteristics																					
		Weight for each requirements (1/20)	Document identifier (Did)	Document identifier manager	Document content reproduction	Document attributes reproduction	Modify history	Undo/redo function	Portable document format	Separate annotation information	High resolution print	Full color print	High speed print	Enlargement and reduction print	Both sides print	N-up print (ex. 2-page per a printpage)	Mark Did on paper	High resolution copy	Full color copy	High speed copy	Enlargement and reduction copy	Both sides copy	N-up copy (ex. 2-page per a copypage)
Technical Design Requirements	Eye-friendly visualization	10									9	9		3			9	9			3		
	Efficient visualize capability	9									9	9	9	9	9		9	9	9	9	9	9	
	Wide visualize area	8								1			9	9	9		1				9	9	9
	Original document information	7	9	9		1				9	3		3	3	3	9	9	3		1	1	1	
	Efficient reproduction	6	1	1	9	9			3	1	9	9	9	3	3	3	9	9	9	9	3	3	3
	Inferior-free reproduction	6	1	1	9	9			3	1	9	9				9	9	9					
	Browse/riffle capability	6									9	9		3	9	9		9	9		3	9	9
	Position free User Interface	5									9												
	Equipment independence	5									9	3	3				3						
	Durable feature	5									3						3						
	Portable equipment	5									3	3	3	1	9	9	3				1	9	9
	Undo/cancel modification	5	3	3	3		9	9		3							3						
	Reusable document format	5							9	1													
	Content-free annotation	4	1	1	3	1	3	3	1	9	3						9						
Total scores			94	94	135	119	57	57	85	68	536	384	165	245	291	291	267	404	354	135	231	277	277
Total order			21	21	14	19	35	35	23	24	1	3	12	10	5	5	9	2	4	14	11	7	7
Order in each doc type			8	8	2	6	22	22	10	11	1	3	12	10	5	5	9	2	4	13	11	7	7

Table 8: QFD Product Design Matrix - Integrated Electronic/Paper Document

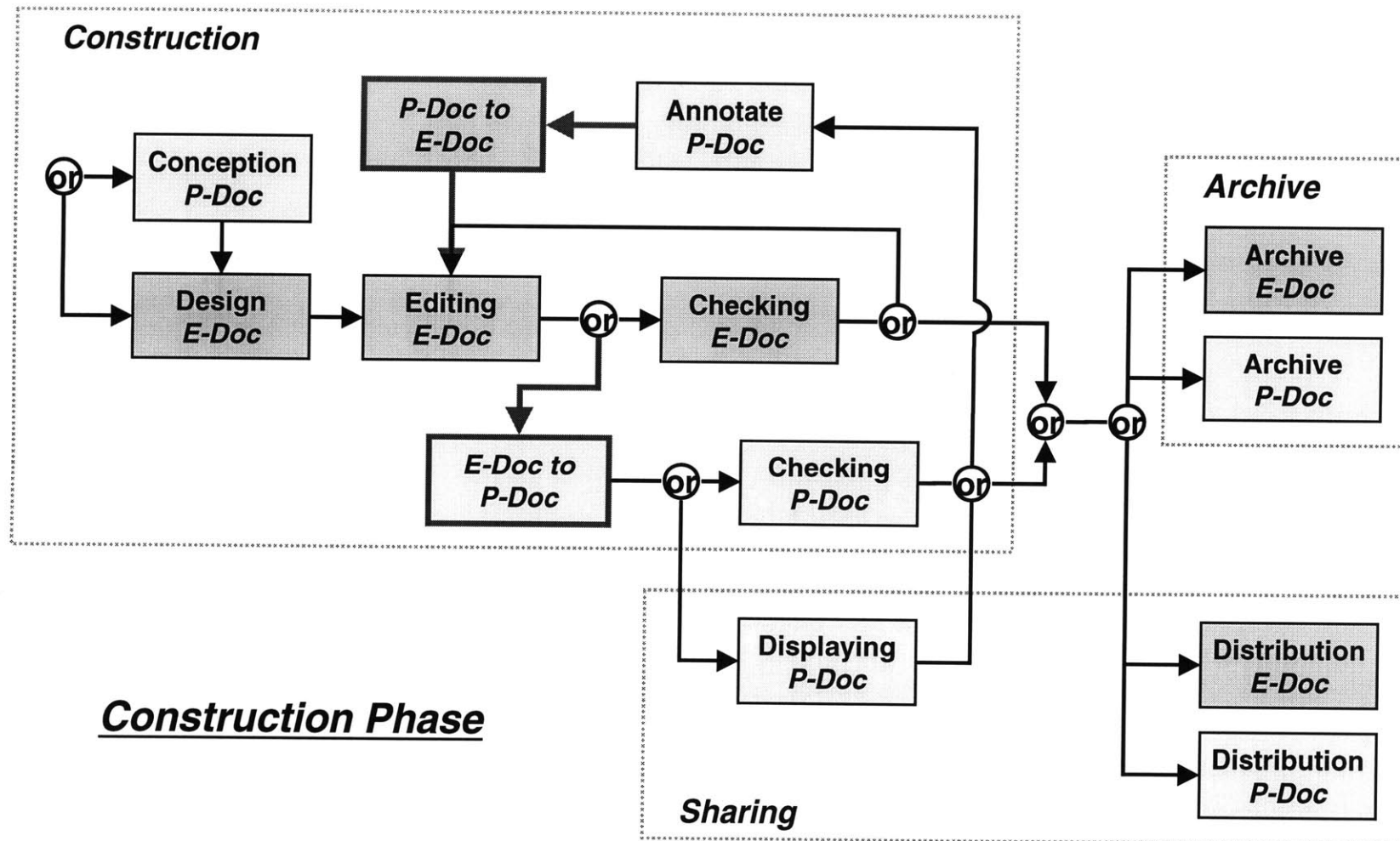


Figure 6: FFBD for Integrated Electronic/Paper Document

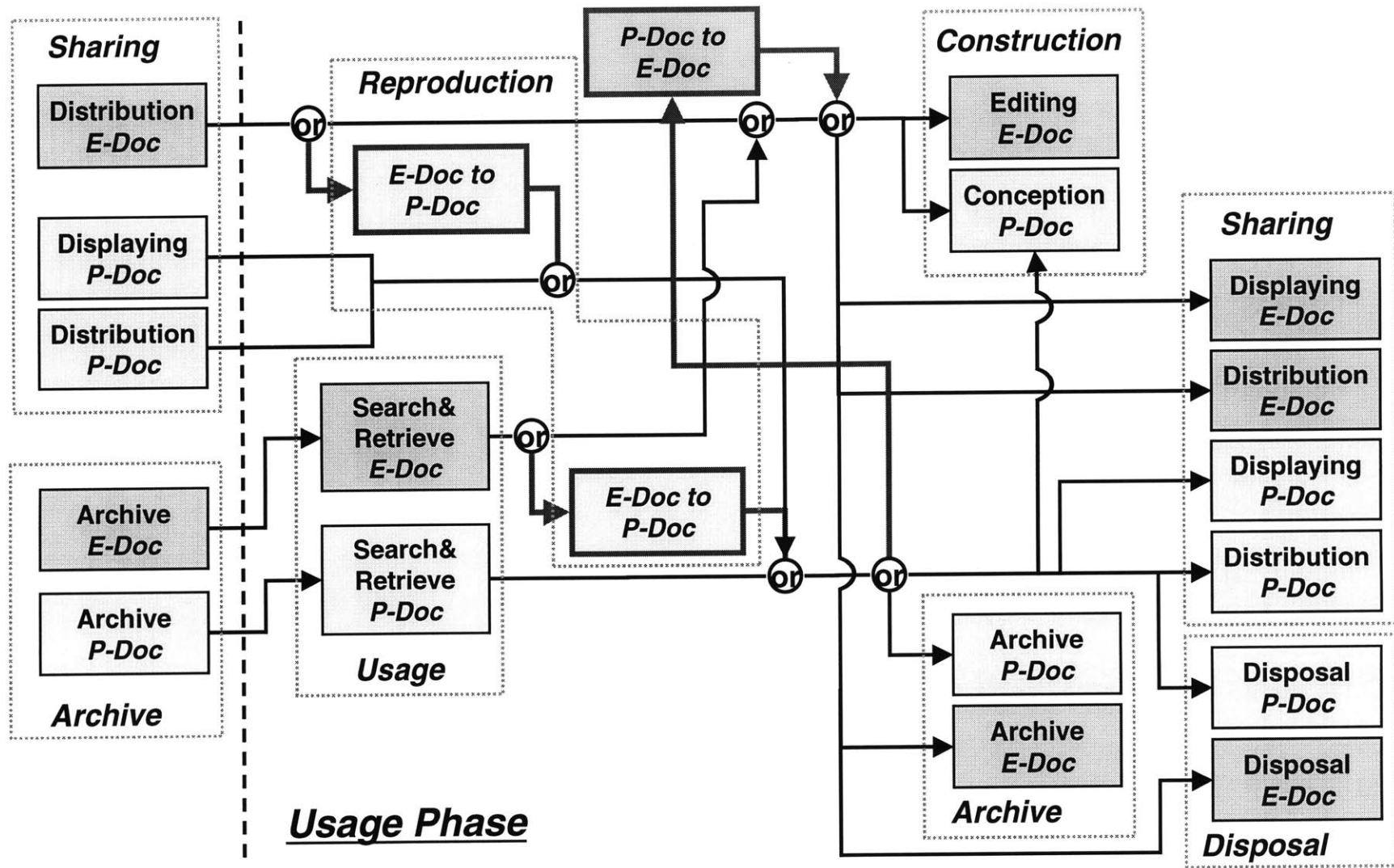


Figure 7: FFBD for Integrated Electronic/Paper Document (cont.)

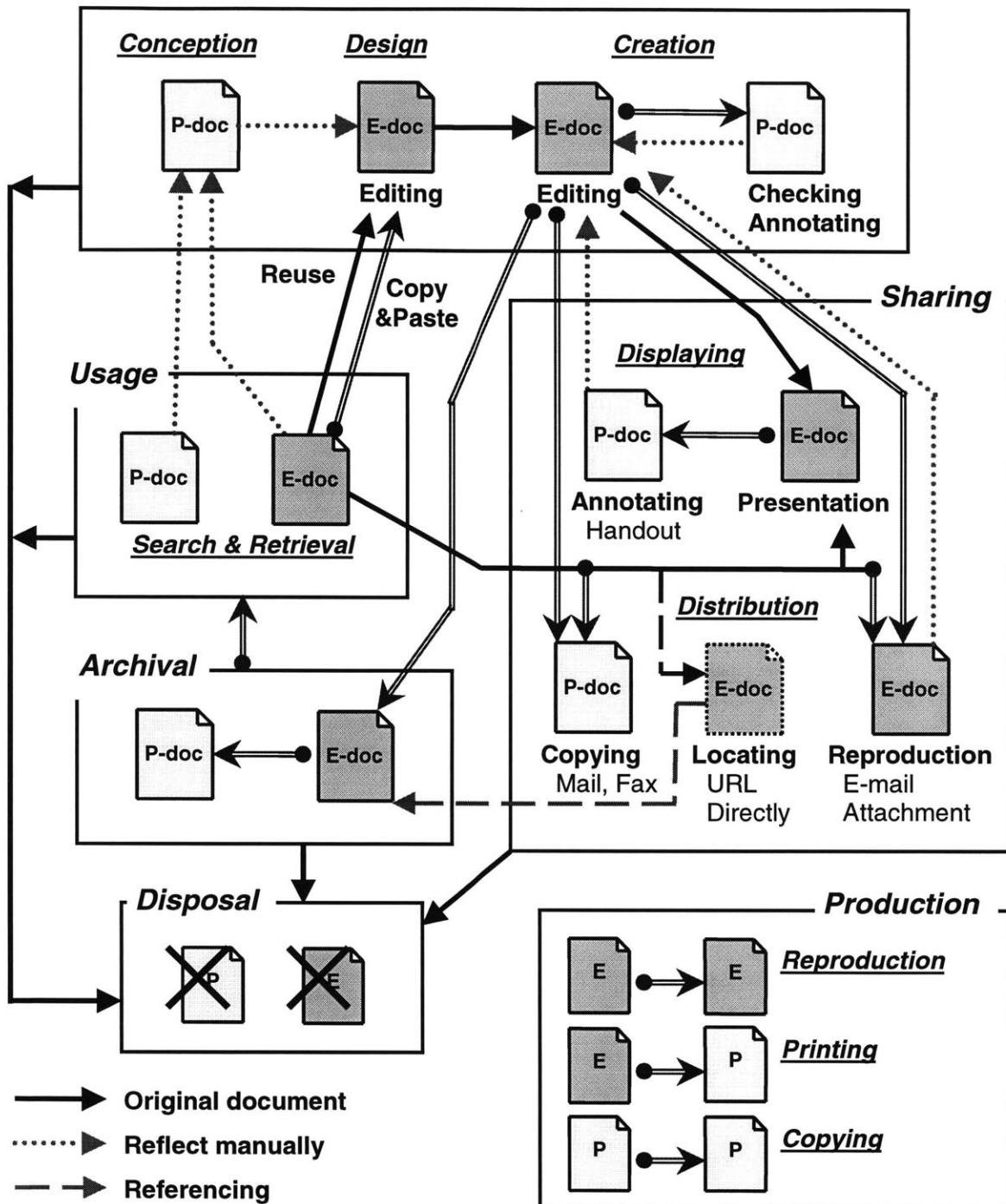


Figure 8: Overview of the Current Document Lifecycle

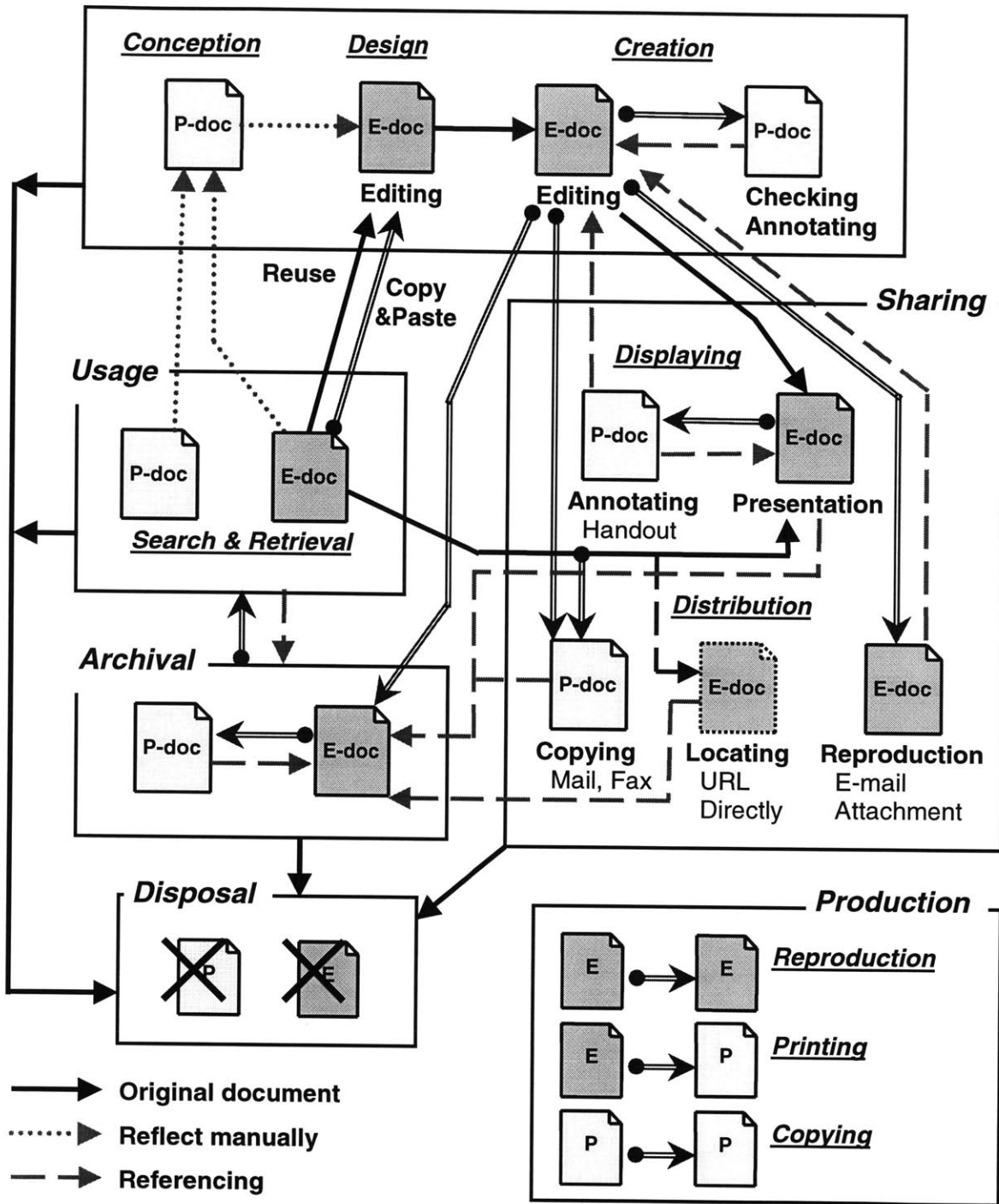


Figure 9: Overview of the Proposed Document Lifecycle

Conclusion

Recently, with the increase in the amount of electronic documents caused by the advancement of office automation development, represented by the availability of better performing personal computers, as well as the increase in the volume of electronic documents distribution with the rapid spread of Internet, there was an initial prediction of the decrease of the use of paper documents. However, the trend is showing an increase of paper documents driven by printouts of these electronic documents. As a result of availability of higher performance of printers and color technologies, this has made it possible to produce high quality printouts more easily causing an increase in paper documents. However, from the users' standpoint, a substantial reason for the advantage of paper as a media over electronic documents' functionality is its superior features such as ease of viewing, handling, portability, and writing. In other words, paper is still the most flexible and user-friendly interface.

Today, there has been an on going effort to include paper's convenience for electronic documents, by addition and improvement of functions in software, and development of a mobile device. However, these movements are only alternatives of particular functions of paper. Until the spread of new electronic technology replaces the paper's media features, such as "electronic paper," an ongoing research at MIT [Comis1998], the advantage of paper will still continue for a while.

This project has analyzed the usage forms of business documents, and proposes a new document lifecycle based on the mutual relationship of electronic documents and paper documents. Furthermore, from this standpoint, electronic documents and paper documents complement each other. It is important to set up the base of mutual circulation of electronic documents and paper documents. This thesis provides an overview of the new document lifecycle, which enables users freely to choose types of documentation media they use, in response to their needs.

Finally, the thesis identifies concepts that might be developed to support the proposed next-generation life cycle. Systems engineering techniques have been used to highlight key features that would be needed in the concept design-development process.

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Appendix 1: Questionnaire

Questionnaire: document processing at your place of business

Let me ask you how you prepare and read business documents.
The result of this questionnaire will be used to develop a new document processing system.
Information from individual questionnaires or responses will not be disclosed to anyone.

There are ten different questions, some multiple choice and some with descriptive responses.
Please answer all parts of each question.
Blue cells denote multiple choice answers. Yellow cells denote write-in (descriptive) answers.

Entry example

Question number

0-1 What is the operating system which you are using?
Please provide the frequency for each item.
0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

0	a. Windows 3.1	Choose a value from the list. (0-4) in this case.
4	b. Windows 95/98	
2	c. Windows NT	
	d. UNIX/SunOS	
	e. Linux/FreeBSD	
1	f. MacOS	0 is assumed if the response field is blank.
3	g. Other <u>OS/2</u>	

Write-in or descriptive response field.

Please specify a concrete instance whenever answering 'Other'.

Multiple choice responses. Please provide a response for each item.
Responses can be entered directly from the keyboard or chosen from the pull-down list using the mouse.
Pressing the Tab key will move the cursor to the next response field.

Only the colored cells can be changed; the value of each cell is restricted to values that are valid responses to the corresponding question.

The following definitions should be used to answer each question.

Document: Any business-related information in hand-written, hardcopy, or electronic format.
Examples: handwritten memos, faxes, e-mail, web pages, spreadsheets, text.

Paper document: Any document accessed/used on a physical medium such as paper or overhead slides.

Electronic document: Any document accessed/used via a computer program.

Print: Send an electronic document to the printer, creating a duplicate paper document.

Printout: The paper document created by printing an electronic document.

Capture: Create an electronic document from a corresponding paper document by using a scanner, digital camera, FAX-to-computer, etc.

This questionnaire is concerned only with business-related documents, regardless of where you use them.
Personal documents (e-mail, newspapers, magazines) read or used at home or work are **excluded**.
Business documents read or used at home are **included** in the scope of this questionnaire.

After you finish the questionnaire, please:

- 1 Save the file using a filename in the following format
FamilynameGivenname.xls (ex. if your name is "William Jefferson Clinton" use "ClintonBill.xls")
- 2 Send the file as an e-mail attachment to **both** <kyouso@mit.edu> and <kyouso@aol.com>
Please make the e-mail subject "**A questionnaire answer**".

Masatomi 'Kyouso' Inagaki
Massachusetts Institute of Technology
System Design and Management Program

Expect the questionnaire to take 20 to 30 minutes.
You may begin, and thank you.

Appendix 1: Questionnaire

1. Questions about your work.

1-1 Please write your e-mail address.

1-2 What is your job type?

Please choose one from 1 to 8.

- _____
1. Research
 2. Product development
 3. Manufacturing
 4. Sales / Marketing
 5. Customer service / Support
 6. Planning
 7. Staff
 8. Other _____

1-3 What is your occupation? Please explain briefly.

1-4 What percent of your job is spent reading, preparing, and editing documents?

Please choose one from 1 to 7 for each.

- _____ a. Reading documents
_____ b. Preparing and editing documents

1. 0 - 5%
2. 6 - 10%
3. 11 - 20%
4. 21 - 30%
5. 31 - 50%
6. 51 - 70%
7. 71 - 100%

Please continue with the next question.

Appendix 1: Questionnaire

2. Questions about preparation/editing electronic documents.

2-1 What kind of applications do you use to prepare/edit electronic documents?
Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Electronic mail (Outlook, Notes, Eudora, etc.)
- ☐ b. Word processor (Word, etc.)
- ☐ c. Spreadsheet (Excel, etc.)
- ☐ d. Presentation editor (PowerPoint, etc.)
- ☐ e. Graphics editor (Photoshop, etc.)
- ☐ f. HTML editor (FrontPage, etc.)
- ☐ g. Source code editor (VisualBasic, etc.)
- ☐ h. Data sheet / Form editor (Access, etc.)
- ☐ i. PDF editor (Acrobat editor, etc.)
- ☐ j. CAD editor (AutoCAD, etc.)
- ☐ k. Text editor (Memopad, etc.)
- ☐ l. Other _____

2-2 Who is the audience of the electronic documents that you prepare/edit?
Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Put own thoughts together or recording for myself
- ☐ b. The team, the project, and the division that I belong to
- ☐ c. Other divisions
- ☐ d. Outside of the company

2-3 Where do you prepare/edit electronic documents?
Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Desk
- ☐ b. Office (workplace, meeting room)
- ☐ c. Home
- ☐ d. Other (Commuter time, etc.)

Please continue with the next question.

Appendix 1: Questionnaire

3. Questions about reading electronic documents.

3-1 What kind of applications do you use to read electronic documents?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Electronic mail (Outlook, Notes, Eudora, etc.)
- ☐ b. Word processor (Word, etc.)
- ☐ c. Spreadsheet (Excel, etc.)
- ☐ d. Presentation editor (PowerPoint, etc.)
- ☐ e. Graphics editor (Photoshop, etc.)
- ☐ f. Web browser (Netscape, Internet Explore, etc.)
- ☐ g. Source code editor (VisualBasic, etc.)
- ☐ h. Data sheet / Form editor (Access, etc.)
- ☐ i. PDF editor (Acrobat editor, etc.)
- ☐ j. CAD editor (AutoCAD, etc.)
- ☐ k. Text editor (Memopad, etc.)
- ☐ l. Other _____

3-2 Who authors the electronic documents you read?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Myself
- ☐ b. The team, the project, and the division that I belong to
- ☐ c. Other divisions
- ☐ d. Outside of the company

3-3 Where do you read electronic documents?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Desk
- ☐ b. Office (workplace, meeting room)
- ☐ c. Home
- ☐ d. Other (Commuter time, etc.)

Please continue with the next question.

Appendix 1: Questionnaire

4. Questions about preparation/editing paper documents.

4-1 What kind of methods do you prepare/edit the paper document?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Print electronic documents
- ☐ b. Copy paper documents
- ☐ c. Pen / Eraser
- ☐ d. Marker
- ☐ e. Tag / Post-it
- ☐ f. Scissors / Paste
- ☐ g. Other _____

4-2 Who is the audience of the paper documents that you prepare/edit?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Put own thoughts together or recording for myself
- ☐ b. The team, the project, and the division that I belong to
- ☐ c. Other divisions
- ☐ d. Outside of the company

4-3 Where do you prepare/edit paper documents?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Desk
- ☐ b. Office (workplace, meeting room)
- ☐ c. Home
- ☐ d. Other (Commuter time, etc.)

Please continue with the next question.

Appendix 1: Questionnaire

5. Questions about reading paper documents.

5-1 Who authors the paper documents you read?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Myself
- ☐ b. The team, the project, and the division that I belong to
- ☐ c. Other divisions
- ☐ d. Outside of the company

5-2 Where do you read paper documents?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Desk
- ☐ b. Office (workplace, meeting room)
- ☐ c. Home
- ☐ d. Other (Commuter time, etc.)

Please continue with the next question.

Appendix 1: Questionnaire

6. Questions about printing electronic documents.

6-1 What kind of applications do you use to print electronic documents?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Electronic mail (Outlook, Notes, Eudora, etc.)
- ☐ b. Word processor (Word, etc.)
- ☐ c. Spreadsheet (Excel, etc.)
- ☐ d. Presentation editor (PowerPoint, etc.)
- ☐ e. Graphics editor (Photoshop, etc.)
- ☐ f. Web browser (Netscape, Internet Explore, etc.)
- ☐ g. Source code editor (VisualBasic, etc.)
- ☐ h. Data sheet / Form editor (Access, etc.)
- ☐ i. PDF editor (Acrobat editor, etc.)
- ☐ j. CAD editor (AutoCAD, etc.)
- ☐ k. Text editor (Memopad, etc.)
- ☐ l. Other _____

6-2 Who creates the electronic documents you print?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Myself
- ☐ b. The team, the project, and the division that I belong to
- ☐ c. Other divisions
- ☐ d. Outside of the company

6-3 What do you print electronic documents on?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- ☐ a. Networked color printer
- ☐ b. Networked black-and-white printer
- ☐ c. Local color printer
- ☐ d. Local black-and-white printer
- ☐ e. Other _____

Appendix 1: Questionnaire

6-4 Why do you print electronic documents?

Please rate the importance of each reason.

0:Not important, 1:Less important, 2:Important, 3:Very important

- _____ a. Because paper is easy to read
- _____ b. Because paper is easy to write
- _____ c. To keep
- _____ d. To distribute
- _____ e. To FAX
- _____ f. To use for overhead projector
- _____ g. To check to content or format
- _____ h. Other _____

6-5 How did the quantity that you printed change over the past 5-6 years?

Please choose one from the three next.

1:Decrease, 2:Doesn't change very much, 3:Increase

6-6 In your opinion, why did the change described in 6-5 occur?

Please give at least three reasons.

Please continue with the next question.

Appendix 1: Questionnaire

7. Questions about copying/capturing paper documents.

7-1 Why do you copy paper documents?

Please rate the importance of each reason.

0:Not important, 1:Less important, 2:Important, 3:Very important

- _____ a. I don't want to add changes to the original
- _____ b. I have to return the original
- _____ c. I want to pick out only a necessary part from the original.
- _____ d. I want to do editing such as enlargement, reduction, and both sides copy
- _____ e. I want to distribute
- _____ f. Other _____

7-2 What kind of paper documents do you capture in electronic documents?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- _____ a. The text of the printed matter, such as books, magazines, and newspapers
- _____ b. Images such as a photographs, pictures
- _____ c. Receiving Faxes by the computer
- _____ d. Printouts
- _____ e. Handwritten documents
- _____ f. Other _____

If you answered 0 to every part of question 7-2, skip to question 7-5, else go to 7-3.

7-3 Who authors the paper documents you capture?

Please provide the frequency for each item.

0:Never, 1:Yearly, 2:Monthly, 3:Weekly, 4:Daily

- _____ a. Myself
- _____ b. The team, the project, and the division that I belong to
- _____ c. Other divisions
- _____ d. Outside of the company

7-4 Why do you capture paper documents?

Please rate the importance of each reason.

0:Not important, 1:Less important, 2:Important, 3:Very important

- _____ a. To edit/proceed content with the computer
- _____ b. To attach/insert it to electronic documents
- _____ c. To store as electronic documents
- _____ d. To distribute as electronic documents
- _____ e. Other _____

Appendix 1: Questionnaire

7-5 When to choose not to capture electronic documents, why is that choice made?

Please rate the importance of each reason.

0:Not important, 1:Less important, 2:Important, 3:Very important

- _____ a. There is no scanner
- _____ b. Don't know how to scan.
- _____ c. Operation and post processing are troublesome
- _____ d. Image quality and resolution restrictions
- _____ e. No need
- _____ f. Other _____

Please continue with the next question.

Appendix 1: Questionnaire

8. Questions about storing/distributing documents.

8-1 How do you store electronic documents?

Please provide the frequency of each method below, to the nearest 10%.

- ☐ a. Store electronic documents only
- ☐ b. Store both electronic documents and their printouts
- ☐ c. Store their printouts only
- ☐ 0 % Total

8-2 Why do you store printouts of some electronic documents?

Please rate the importance of each reason.

0:Not important, 1:Less important, 2:Important, 3:Very important

- ☐ a. Because paper is easy to read later
- ☐ b. Because paper is easy to search later
- ☐ c. Because paper is easy to combine various materials together
- ☐ d. Because of the regulations and the habits
- ☐ e. Because the application which copes with it might be gone
- ☐ f. Other _____

8-3 How do you distribute electronic documents?

Please provide the frequency of each method below, to the nearest 10%.

- ☐ a. Distribute electronic documents only
- ☐ b. Distribute both electronic documents and their printouts
- ☐ c. Distribute their printouts only
- ☐ 0 % Total

8-4 Why do you distribute printouts of some electronic documents?

Please rate the importance of each reason.

0:Not important, 1:Less important, 2:Important, 3:Very important

- ☐ a. Because I don't want to distribute them in electronic format
- ☐ b. Because I distribute paper documents as handouts at presentations or meetings
- ☐ c. Because the audience required printouts
- ☐ d. Because of regulations or habits
- ☐ e. Because there is no computer in the place of distribution
- ☐ f. Because the place of distribution isn't connected to the network
- ☐ g. Because the place of distribution doesn't have the appropriate application
- ☐ h. Other _____

Please continue with the next question.

Appendix 1: Questionnaire

9. Questions about the comparison between electronic documents and paper documents.

9-1 What do you think the advantages of electronic documents are?

Please rate the importance of each reason.

0:Not important, 1:Less important, 2:Important, 3:Very important

- _____ a. Easy to distribute (distant places, many people, easy to share, immediately)
- _____ b. Easy to store (less space, easy to organize)
- _____ c. Easy to reproduce (same content and quality as original)
- _____ d. Easy to modify
- _____ e. Easy to reuse
- _____ f. Can record the attribute information (who made it, when it was made)
- _____ g. Can be search/classified based on the attribute information
- _____ h. Easier to control access than paper documents
- _____ i. Can be search based on content information (full text search)
- _____ j. Easier to make color document than paper documents
- _____ k. Can be made multimedia document (audio, video)
- _____ l. Can be displayed independently from contents (reduction, different viewers)
- _____ m. Data can be automatically processed and updated (ex. spreadsheet)
- _____ n. Improves the appearance of documents
- _____ o. Other _____
- _____ p. Other _____

9-2 What do you think the disadvantages of electronic documents are?

Please rate the importance of each reason.

0:Not important, 1:Less important, 2:Important, 3:Very important

- _____ a. Needs a computer
- _____ b. Needs an appropriate application (includes different versions)
- _____ c. Needs knowledge about how to use the application
- _____ d. Hard to read (taxes eyes)
- _____ e. The whole can't be looked over (a screen is small)
- _____ f. Can't look briefly.
- _____ g. Distribution is easy (mis-information and secret information)
- _____ h. It is easy to re-use without permission
- _____ i. Can record the attribute such as who made it (infringement on privacy)
- _____ j. Difficult to annotate
- _____ k. It takes more time to arrive at the desired format
- _____ l. Can't be physical identified by a signature and/or seal
- _____ m. Other _____
- _____ n. Other _____

Appendix 1: Questionnaire

9-3 What do you think the advantages of paper documents are?

Please rate the importance of each reason.

0:Not important, 1:Less important, 2:Important, 3:Very important

- _____ a. Easy to read
- _____ b. Usable almost anywhere (can be read while lying down)
- _____ c. Easy to carry
- _____ d. Can write information anywhere anyway
- _____ e. Can annotate easily
- _____ f. Can be glanced through easily
- _____ g. Can be displayed anywhere (wall, etc.)
- _____ h. Information can be remembered with the physical attributes
(paper quality, paper color, coffee stains, etc)
- _____ i. Personal information can be gathered (handwritten note)
- _____ j. Can be physically identified using a signature and/or seal
- _____ k. Variety of formats can be combined easily
- _____ l. Other _____
- _____ m. Other _____

9-4 What do you think the disadvantages of paper documents are?

Please rate the importance of each reason.

0:Not important, 1:Less important, 2:Important, 3:Very important

- _____ a. Bulky (requires storage space, the cost of cabinets)
- _____ b. Hard to organize a collection of documents
- _____ c. Hard to edit
- _____ d. Hard to reuse
- _____ e. Hard to reproduce (inferior copy quality)
- _____ f. Hard to distribute (distant places, many people)
- _____ g. Hard to find (Uncertain where it is)
- _____ h. Environmental impact (save trees!)
- _____ i. Other _____
- _____ j. Other _____

9-5 What will you think is necessary to increase the use of electronic documents?

Please give at least three things you think are necessary.

Please continue with the next question.

Appendix 1: Questionnaire

10. Questions about overall document information.

10-1 What is the necessary information (attributes) about each document, independent from its content?

Please rate the importance of each attribute.

0:Not important, 1:Less important, 2:Important, 3:Very important

- _____ a. Who made it
- _____ b. When it was made
- _____ c. Who changed it and when
- _____ d. Who saw it and when reviewed
- _____ e. Who copied it and when copied
- _____ f. Who should see it
- _____ g. Who shouldn't to see it (access control)
- _____ h. What edition
- _____ i. Security classification
- _____ j. Purpose
- _____ k. What is the original document (pointer to original version)
- _____ l. Where is this document physically located
- _____ m. Who is referring to via links
- _____ n. Who printed it
- _____ o. Other _____
- _____ p. Other _____

10-2 If you could reliably match a printout with its corresponding electronic documents, which tasks would you like to perform?

Please rate the importance of each requirement.

0:Not important, 1:Less important, 2:Important, 3:Very important

- _____ a. Get the electronic document from which the printout was made,
ignoring any changes made after printing (the original version)
- _____ b. Get the electronic document from which the printout was made,
including changes made after printing (the latest version)
- _____ c. Want to view the attributes
- _____ d. Update the electronic document with annotations on the printout
- _____ e. Get high quality or color printout of the original electronic document
- _____ f. Get a printout of the latest version of the electronic document
- _____ g. Want to see other people's comments
- _____ h. Other _____
- _____ i. Other _____

Appendix 1: Questionnaire

10-3 If you could reliably track all paper copies of an electronic document, which tasks would you like to perform?

Please rate the importance of each requirement.

0:Not important, 1:Less important, 2:Important, 3:Very important

- _____ a. Want to know where the printouts are now
- _____ b. Want to know who has the printouts
- _____ c. Want to know where printout was used (conference, etc.)
- _____ d. Want to know how many copies were copied and when
- _____ e. Want to know information about the printouts of the current
electronic document and all of its previous versions
- _____ f. Other _____
- _____ g. Other _____

Thank you very much for your cooperation.

Appendix 2: Results of the survey

Appendix 2: Results of the Survey

Working country

42	USA
52	Japan
7	Other
<hr/>	
101	Total

Job type (Q1-2)

16	1. Research
36	2. Product development
2	3. Manufacturing
10	4. Sales / Marketing
10	5. Customer service / Support
11	6. Planning
12	7. Staff
4	8. Other

Percent of work time spent in job (Q1-4)

Reading documents (Q1-4.a)

Ave	29.7 %
<hr/>	
0	1. 0 - 5%
12	2. 6 - 10%
19	3. 11 - 20%
32	4. 21 - 30%
24	5. 31 - 50%
11	6. 51 - 70%
2	7. 71 - 100%

Preparing and editing documents (Q1-4.b)

Ave	27.2 %
<hr/>	
2	1. 0 - 5%
10	2. 6 - 10%
22	3. 11 - 20%
34	4. 21 - 30%
21	5. 31 - 50%
6	6. 51 - 70%
2	7. 71 - 100%

Appendix 2: Results of the Survey

Applications frequency: prepare/edit electronic documents (Q2-1)

0:N	1:Y	2:M	3:W	4:D	Ave	
5	0	1	4	91	3.7	a. Electronic mail
2	1	5	23	70	3.6	b. Word processor
5	11	21	34	30	2.7	c. Spreadsheet
10	9	28	37	17	2.4	d. Presentation editor
44	25	22	9	1	1.0	e. Graphics editor
54	20	14	11	2	0.9	f. HTML editor
66	16	7	8	4	0.7	g. Source code editor
54	22	18	3	4	0.8	h. Data sheet / Form editor
57	18	15	6	5	0.9	i. PDF editor
92	7	0	2	0	0.1	j. CAD editor
35	8	16	17	25	1.9	k. Text editor
82	0	1	8	10	0.7	l. Other

Audiences of electronic documents for prepare/edit (Q2-2)

0:N	1:Y	2:M	3:W	4:D	Ave	
3	5	12	23	58	3.3	a. Myself
4	2	4	23	68	3.5	b. Own team, project, and division
15	11	21	31	23	2.4	c. Other divisions
9	23	37	21	11	2.0	d. Outside of the company

Prepare/edit electronic document locations (Q2-3)

0:N	1:Y	2:M	3:W	4:D	Ave	
4	0	1	3	93	3.8	a. Desk
25	9	15	27	25	2.2	b. Office (workplace, meeting room)
20	20	11	18	30	2.2	c. Home
69	8	12	10	2	0.7	d. Other (Commuter time, etc.)

Appendix 2: Results of the Survey

Applications frequency: read electronic documents (Q3-1)

0:N	1:Y	2:M	3:W	4:D	Ave	
3	0	0	2	96	3.9	a. Electronic mail
1	3	4	18	75	3.6	b. Word processor
5	2	14	35	45	3.1	c. Spreadsheet
11	4	18	39	29	2.7	d. Presentation editor
55	9	19	12	6	1.1	e. Graphics editor
4	2	1	9	85	3.7	f. Web browser
65	13	8	11	4	0.8	g. Source code editor
51	17	23	6	4	1.0	h. Data sheet / Form editor
22	5	22	30	22	2.2	i. PDF reader
87	5	5	3	1	0.3	j. CAD editor
29	9	19	21	23	2.0	k. Text editor
86	1	1	3	10	0.5	l. Other

Authors of electronic documents for read (Q3-2)

0:N	1:Y	2:M	3:W	4:D	Ave	
4	1	9	18	69	3.5	a. Myself
7	0	2	15	77	3.5	b. Own team, project, and division
16	1	11	29	44	2.8	c. Other divisions
8	4	21	27	41	2.9	d. Outside of the company

Read electronic document locations (Q3-3)

0:N	1:Y	2:M	3:W	4:D	Ave	
4	0	0	1	96	3.8	a. Desk
20	3	18	25	35	2.5	b. Office (workplace, meeting room)
18	4	15	38	26	2.5	c. Home
60	10	12	10	9	1.0	d. Other (Commuter time, etc.)

Appendix 2: Results of the Survey

Methods frequency: prepare/edit paper documents (Q4-1)

0:N	1:Y	2:M	3:W	4:D	Ave	
0	0	1	12	88	3.9	a. Print electronic documents
6	2	7	42	44	3.1	b. Copy paper documents
7	10	9	23	52	3.0	c. Pen / Eraser
24	15	17	29	16	2.0	d. Marker
8	10	15	36	32	2.7	e. Tag / Post-it
46	28	19	7	1	0.9	f. Scissors / Paste
90	0	2	8	1	0.3	g. Other

Audiences of paper documents for prepare/edit (Q4-2)

0:N	1:Y	2:M	3:W	4:D	Ave	
3	3	5	22	68	3.5	a. Myself
9	4	11	39	38	2.9	b. Own team, project, and division
31	11	22	25	12	1.8	c. Other divisions
28	25	29	14	5	1.4	d. Outside of the company

Prepare/edit paper document locations (Q4-3)

0:N	1:Y	2:M	3:W	4:D	Ave	
6	0	1	17	77	3.6	a. Desk
14	4	7	36	40	2.8	b. Office (workplace, meeting room)
29	16	19	23	14	1.8	c. Home
65	15	10	8	3	0.7	d. Other (Commuter time, etc.)

Appendix 2: Results of the Survey

Authors of paper documents for read (Q5-1)

0:N	1:Y	2:M	3:W	4:D	Ave	
4	2	12	28	55	3.3	a. Myself
3	1	15	37	45	3.2	b. Own team, project, and division
14	6	27	32	22	2.4	c. Other divisions
12	10	29	29	21	2.4	d. Outside of the company

Read paper document locations (Q5-2)

0:N	1:Y	2:M	3:W	4:D	Ave	
4	1	1	19	76	3.6	a. Desk
11	2	9	32	47	3.0	b. Office (workplace, meeting room)
15	13	16	29	28	2.4	c. Home
45	16	16	12	12	1.3	d. Other (Commuter time, etc.)

Appendix 2: Results of the Survey

Applications frequency: print electronic documents (Q6-1)

0:N	1:Y	2:M	3:W	4:D	Ave	
5	1	7	30	58	3.3	a. Electronic mail
1	1	6	31	62	3.5	b. Word processor
4	6	19	36	36	2.9	c. Spreadsheet
9	5	33	35	19	2.5	d. Presentation editor
57	10	21	11	2	0.9	e. Graphics editor
6	3	10	47	35	3.0	f. Web browser
74	13	8	4	2	0.5	g. Source code editor
60	19	13	8	1	0.7	h. Data sheet / Form editor
30	6	30	24	11	1.8	i. PDF reader
92	3	4	2	0	0.2	j. CAD editor
39	15	20	17	10	1.4	k. Text editor
83	1	5	0	7	0.4	l. Other

Authors of electronic documents for print (Q6-2)

0:N	1:Y	2:M	3:W	4:D	Ave	
3	2	11	38	47	3.2	a. Myself
4	2	10	35	50	3.2	b. Own team, project, and division
15	7	20	36	23	2.4	c. Other divisions
8	11	26	31	25	2.5	d. Outside of the company

Type of printers (Q6-3)

0:N	1:Y	2:M	3:W	4:D	Ave	
26	11	21	32	11	1.9	a. Networked color printer
7	1	3	14	76	3.5	b. Networked black-and-white printer
67	8	10	10	6	0.8	c. Local color printer
75	6	3	2	15	0.8	d. Local black-and-white printer
101	0	0	0	0	0.0	e. Other

Reasons to print electronic documents (Q6-4)

0:N	1:L	2:I	3:V	Ave	
3	4	19	75	2.6	a. Because paper is easy to read
8	10	21	62	2.4	b. Because paper is easy to write
15	31	29	26	1.7	c. To keep
18	21	30	32	1.8	d. To distribute
26	43	21	11	1.2	e. To FAX
25	28	31	17	1.4	f. To use for overhead projector
6	14	37	44	2.2	g. To check to content or format
86	1	5	9	0.4	h. Other

Appendix 2: Results of the Survey

The quantity of printing over the past 5-6 years (Q6-5)

2.2 Ave

26 1. Decrease

25 2. Doesn't change

48 3. Increase

Appendix 2: Results of the Survey

Reasons to copy paper documents (Q7-1)

0:N	1:L	2:I	3:V	Ave	
21	24	23	33	1.7	a. Don't want to add changes to the original
7	11	20	63	2.4	b. Have to return the original
16	29	29	27	1.7	c. Pick out a necessary part from the original
19	39	30	13	1.4	d. Editing such as enlargement, both sides copy
4	13	20	64	2.4	e. To distribute
94	0	0	7	0.2	f. Other

Kind of paper documents to capture in electronic documents (Q7-2)

0:N	1:Y	2:M	3:W	4:D	Ave	
26	24	12	9	2	1.1	a. The text of the printed matter
14	22	23	13	1	1.5	b. Images such as a photographs, pictures
43	14	9	5	2	0.8	c. Receiving Faxes by the computer
38	11	8	13	3	1.1	d. Printouts
32	21	7	9	3	1.0	e. Handwritten documents
71	0	0	0	2	0.1	f. Other

Authors of paper documents to capture (Q7-3)

0:N	1:Y	2:M	3:W	4:D	Ave	
30	17	11	8	7	1.2	a. Myself
22	16	15	12	8	1.6	b. Own team, project, and division
35	15	14	5	4	1.0	c. Other divisions
19	17	23	10	4	1.5	d. Outside of the company

Reasons to capture paper documents (Q7-4)

0:N	1:L	2:I	3:V	Ave	
22	15	15	21	1.5	a. To edit/proceed content with the computer
14	6	19	34	2.0	b. To attach/insert it to electronic documents
14	11	22	26	1.8	c. To store as electronic documents
14	12	18	29	1.8	d. To distribute as electronic documents
69	1	0	3	0.1	e. Other

Appendix 2: Results of the Survey

Reasons to not capture paper documents (Q7-5)

0:N	1:L	2:I	3:V	Ave	
37	11	12	31	1.4	a. There is no scanner
67	13	5	6	0.5	b. Don't know how to scan.
29	24	19	19	1.3	c. Operation and post processing are troublesome
31	20	26	14	1.3	d. Image quality and resolution restrictions
28	14	19	30	1.6	e. No need
79	0	3	9	0.4	f. Other

Appendix 2: Results of the Survey

Methods to store electronic documents (Q8-1)

65.2 %	a. Store electronic documents only
25.9 %	b. Store both electronic documents and their printouts
9.6 %	c. Store their printouts only

Reasons to store printouts of some electronic documents (Q8-2)

0:N	1:L	2:I	3:V	Ave	
11	15	27	46	2.1	a. Paper is easy to read later
22	35	23	19	1.4	b. Paper is easy to search later
20	29	27	23	1.5	c. Paper is easy to combine various materials together
40	16	25	18	1.2	d. The regulations and the habits
41	27	19	12	1.0	e. The application which copes with it might be gone
72	0	6	21	0.8	f. Other

Methods to distribute electronic documents (Q8-3)

72.8 %	a. Distribute electronic documents only
11.1 %	b. Distribute both electronic documents and their printouts
16.2 %	c. Distribute their printouts only

Reasons to distribute printouts of some electronic documents (Q8-4)

0:N	1:L	2:I	3:V	Ave	
43	22	15	18	1.1	a. Don't want to distribute them in electronic format
8	4	23	63	2.4	b. As handouts at presentations or meetings
20	13	26	39	1.9	c. The audience required printouts
36	26	21	15	1.2	d. Regulations or habits
45	15	21	17	1.1	e. No computer in the place of distribution
39	16	24	19	1.2	f. The audience isn't connected to the network
47	16	22	13	1.0	g. The audience doesn't have the application
85	0	4	9	0.4	h. Other

Appendix 2: Results of the Survey

The advantages of electronic documents (Q9-1)

0:N	1:L	2:I	3:V	Ave	
0	0	5	94	2.9	a. Easy to distribute
0	7	12	80	2.7	b. Easy to store
2	4	22	71	2.6	c. Easy to reproduce
1	3	16	79	2.7	d. Easy to modify
0	1	17	81	2.8	e. Easy to reuse
13	45	25	16	1.4	f. Can record the attribute information
9	35	26	29	1.8	g. Can be search/classified based on the attribute
17	30	34	18	1.5	h. Easier to control access than paper documents
5	16	25	53	2.3	i. Can be search based on content
12	32	31	24	1.7	j. Easier to make color document than paper documents
21	41	27	10	1.3	k. Can be made multimedia document
23	37	28	11	1.3	l. Can be displayed independently from contents
6	11	30	52	2.3	m. Data can be automatically processed and updated
9	12	38	40	2.1	n. Improves the appearance of documents
88	0	2	9	0.3	o. Other
97	0	0	2	0.1	p. Other

The disadvantages of electronic documents (Q9-2)

0:N	1:L	2:I	3:V	Ave	
9	18	18	54	2.2	a. Needs a computer
2	11	36	50	2.4	b. Needs an appropriate application
12	20	40	27	1.8	c. Needs knowledge about how to use the application
9	14	28	48	2.2	d. Hard to read
5	9	25	60	2.4	e. The whole can't be looked over
8	15	23	53	2.2	f. Can't look briefly.
18	29	34	18	1.5	g. Easy to mis-distribution
14	38	28	19	1.5	h. Easy to re-use without permission
28	50	16	5	1.0	i. Can record the attribute such as who made it
15	36	27	21	1.5	j. Difficult to annotate
25	30	26	18	1.4	k. Takes more time to arrive at the desired format
22	34	23	20	1.4	l. Can't be physical identified by a signature and/or seal
88	0	1	10	0.3	m. Other
97	0	1	1	0.1	n. Other

Appendix 2: Results of the Survey

The advantages of paper documents (Q9-3)

0:N	1:L	2:I	3:V	Ave	
2	3	11	83	2.8	a. Easy to read
2	4	15	78	2.7	b. Usable almost anywhere
3	10	25	61	2.5	c. Easy to carry
4	3	26	66	2.6	d. Can write information anywhere anyway
6	6	31	56	2.4	e. Can annotate easily
3	8	26	62	2.5	f. Can be glanced through easily
8	18	34	39	2.1	g. Can be displayed anywhere
25	34	18	22	1.4	h. Information can be remembered with the physical attributes
18	25	35	21	1.6	i. Personal information can be gathered
16	29	28	26	1.6	j. Can be physical identified using a signature and/or seal
18	35	25	21	1.5	k. Variety of formats can be combined easily
88	1	2	8	0.3	l. Other
95	1	2	1	0.1	m. Other

The disadvantages of paper documents (Q9-4)

0:N	1:L	2:I	3:V	Ave	
4	5	25	65	2.5	a. Bulky
6	7	25	61	2.4	b. Hard to organize a collection of documents
10	15	16	58	2.2	c. Hard to edit
7	11	21	60	2.4	d. Hard to reuse
15	27	29	28	1.7	e. Hard to reproduce (inferior copy quality)
6	21	27	45	2.1	f. Hard to distribute
6	15	33	45	2.2	g. Hard to find
10	22	32	35	1.9	h. Environmental impact
91	1	1	6	0.2	i. Other
98	1	0	0	0.0	j. Other

Appendix 2: Results of the Survey

Necessary attributes information (Q10-1)

0:N	1:L	2:I	3:V	Ave	
2	8	28	61	2.5	a. Who made it
0	4	28	67	2.6	b. When it was made
1	12	45	41	2.3	c. Who changed it and when
10	32	43	14	1.6	d. Who saw it and when reviewed
17	43	33	6	1.3	e. Who copied it and when copied
7	28	35	29	1.9	f. Who should see it
6	18	30	45	2.2	g. Who shouldn't to see it (access control)
5	23	32	39	2.1	h. What edition
5	21	28	45	2.1	i. Security classification
9	21	29	40	2.0	j. Purpose
11	21	43	24	1.8	k. What is the original document
13	22	30	34	1.9	l. Where is this document physically located
13	37	33	16	1.5	m. Who is referring to via links
28	45	18	8	1.1	n. Who printed it
87	1	6	5	0.3	o. Other
96	1	1	1	0.1	p. Other

If you could reliably match a printout with its corresponding electronic documents, which tasks would you like to perform? (Q10-2)

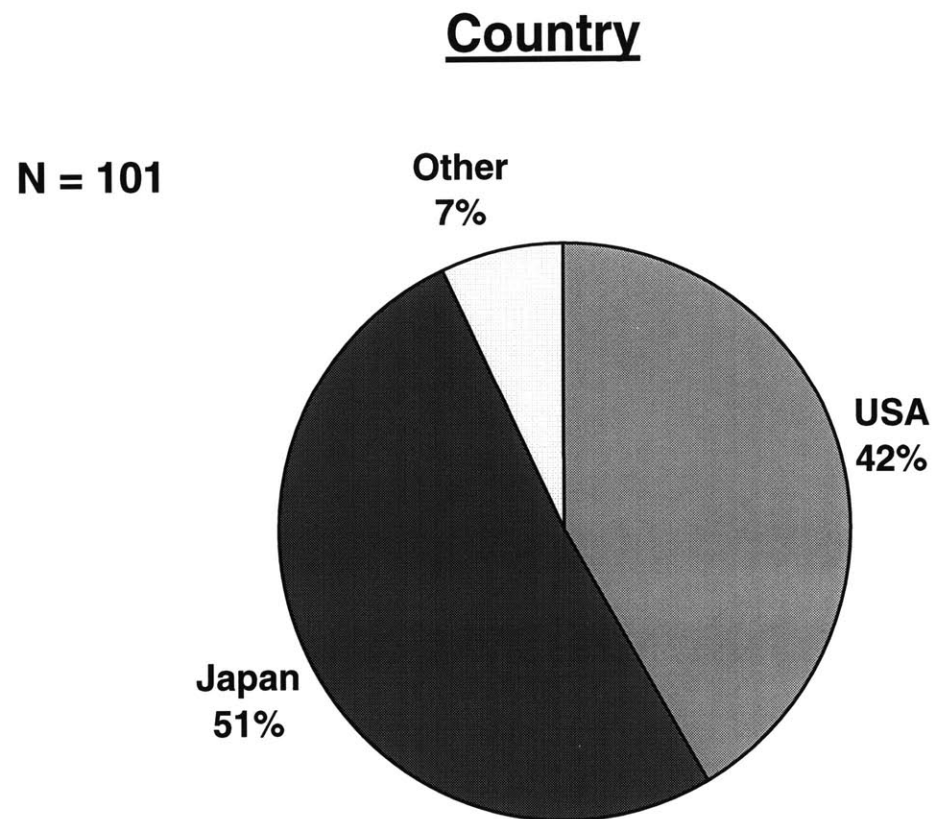
0:N	1:L	2:I	3:V	Ave	
12	22	31	34	1.9	a. Get the original electronic document
6	6	29	58	2.4	b. Get the latest version of the electronic document
17	33	35	14	1.5	c. Want to view the attributes
13	14	40	32	1.9	d. Update the e-document with annotations on the printout
17	32	26	24	1.6	e. Get high quality or color printout of the e-document
9	15	32	43	2.1	f. Get a printout of the latest version of the e-document
9	25	43	22	1.8	g. Want to see other people's comments
93	0	3	3	0.2	h. Other
99	0	0	0	0.0	i. Other

If you could reliably track all paper copies of an electronic document, which tasks would you like to perform? (Q10-3)

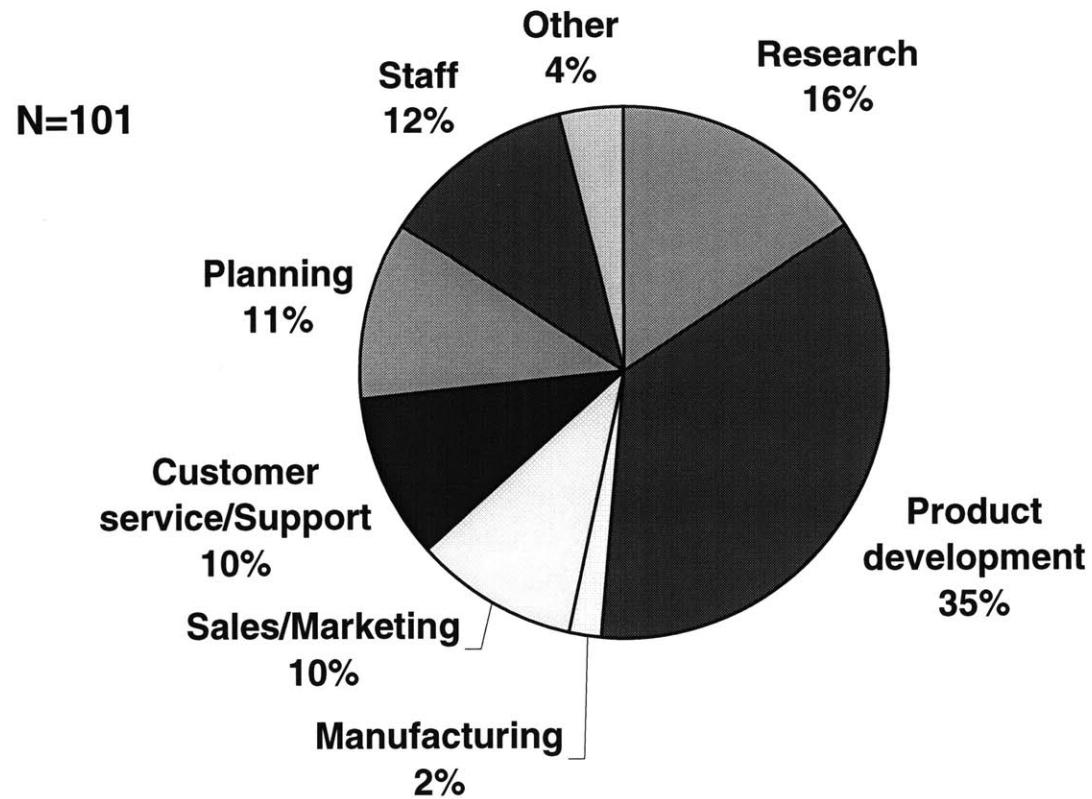
0:N	1:L	2:I	3:V	Ave	
21	37	30	11	1.3	a. Want to know where the printouts are now
18	25	37	19	1.6	b. Want to know who has the printouts
20	26	35	18	1.5	c. Want to know where printout was used
28	37	24	10	1.2	d. Want to know how many copies were copied and when
20	41	27	11	1.3	e. Want to know information about the printouts
90	0	3	6	0.2	f. Other
98	0	0	1	0.0	g. Other

Appendix 3: Results of the survey (Charts)

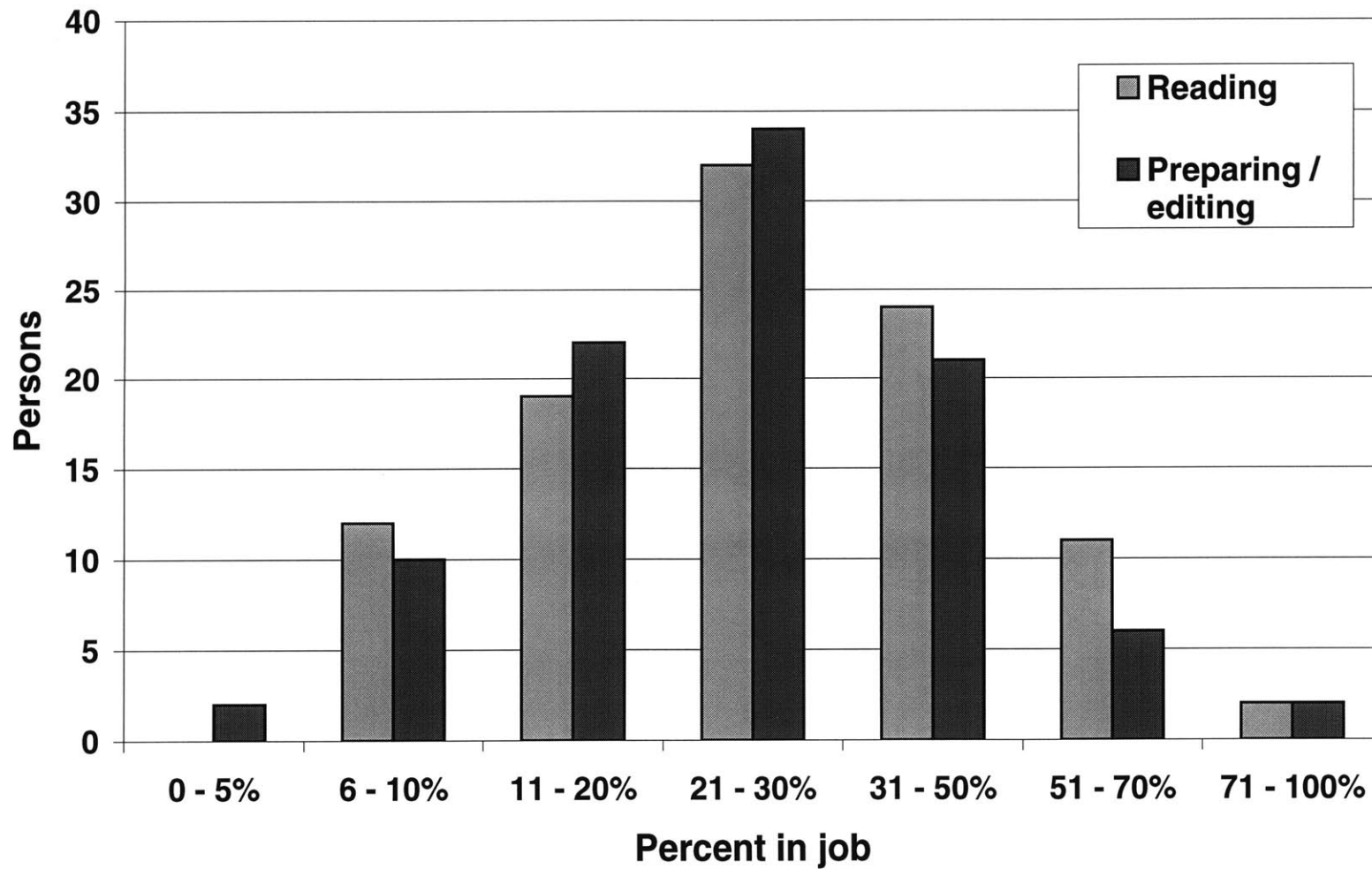
Appendix 3: Results of the Survey (Charts)



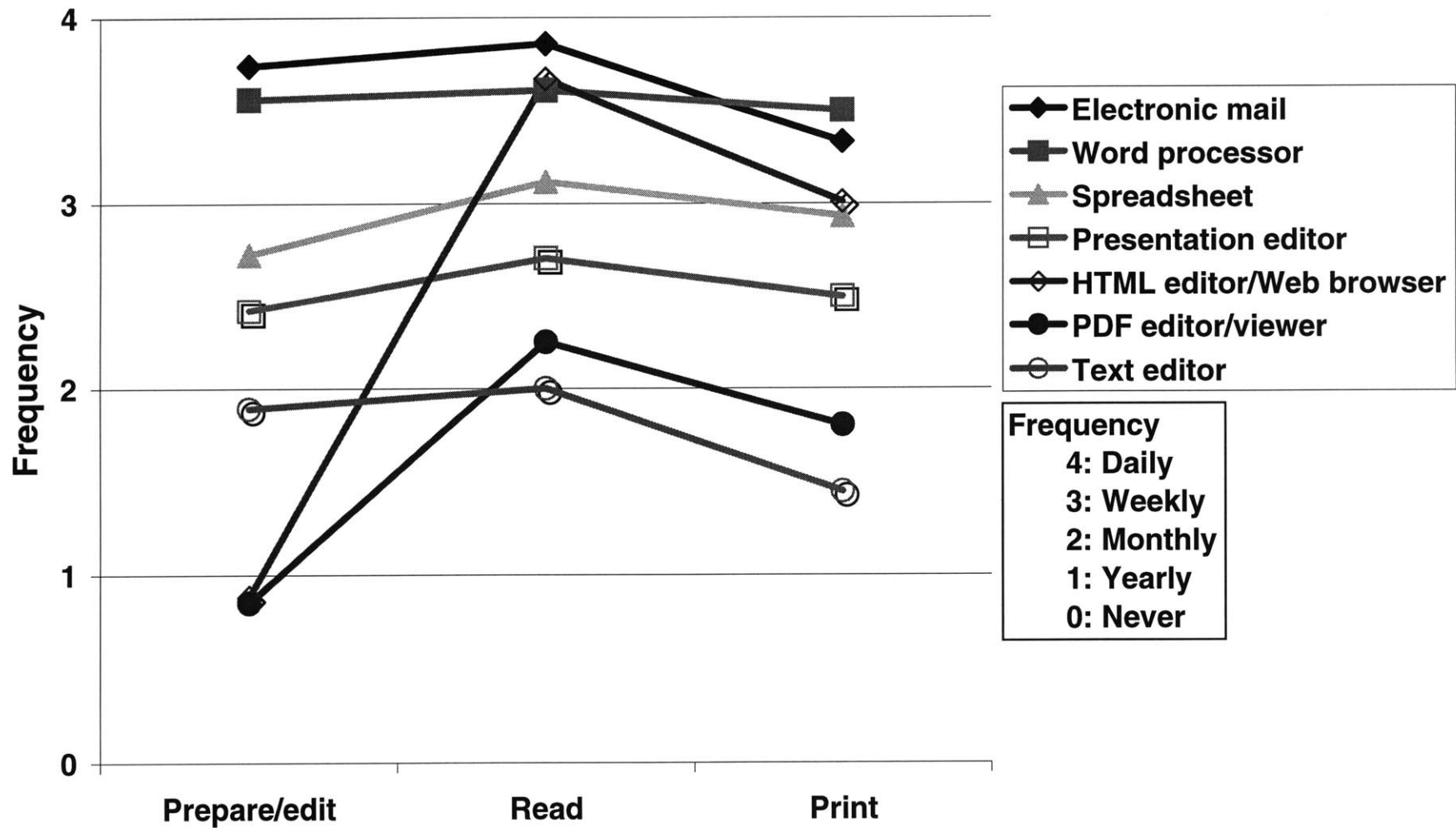
Job Type



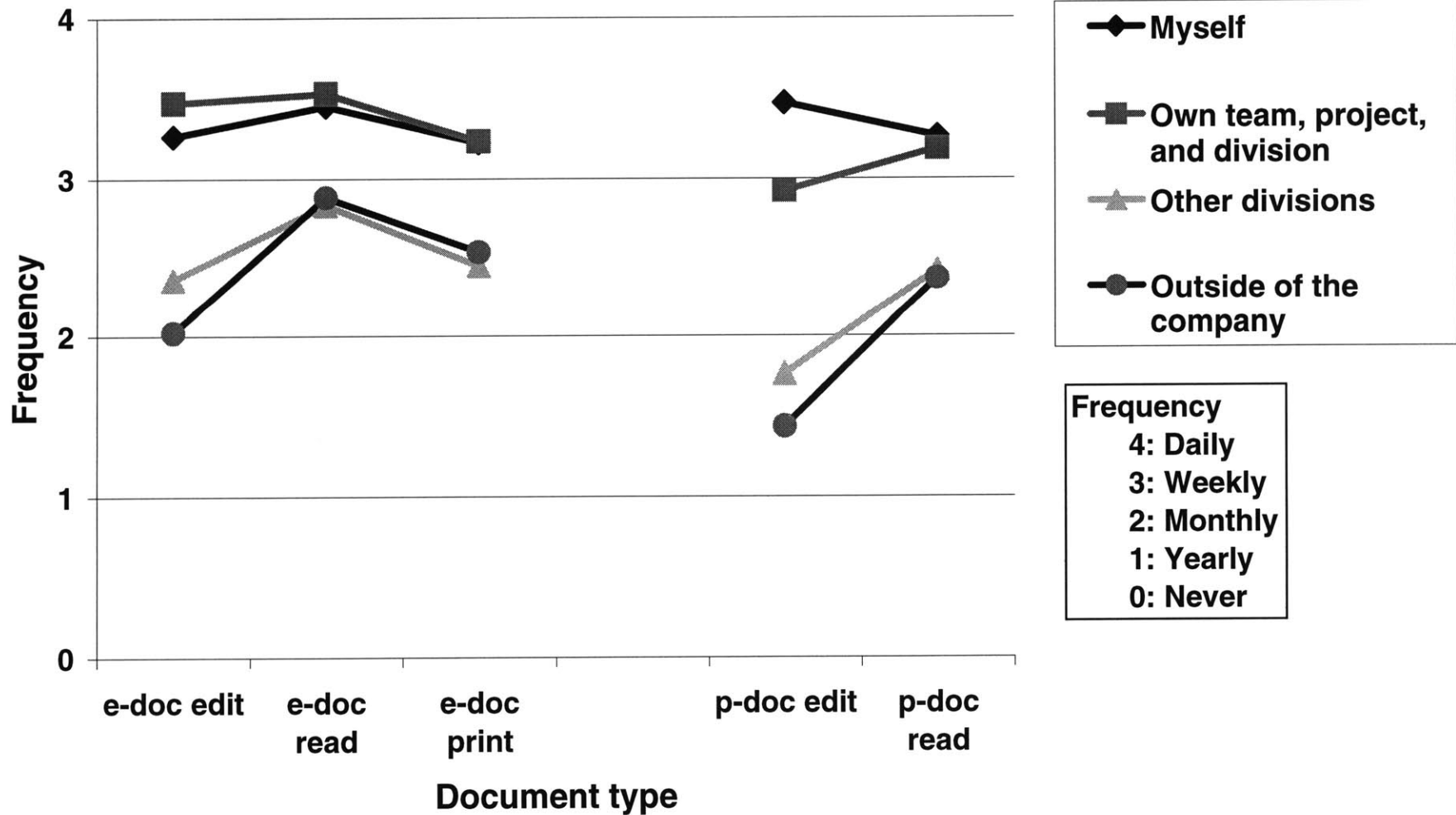
Spend time in document processing



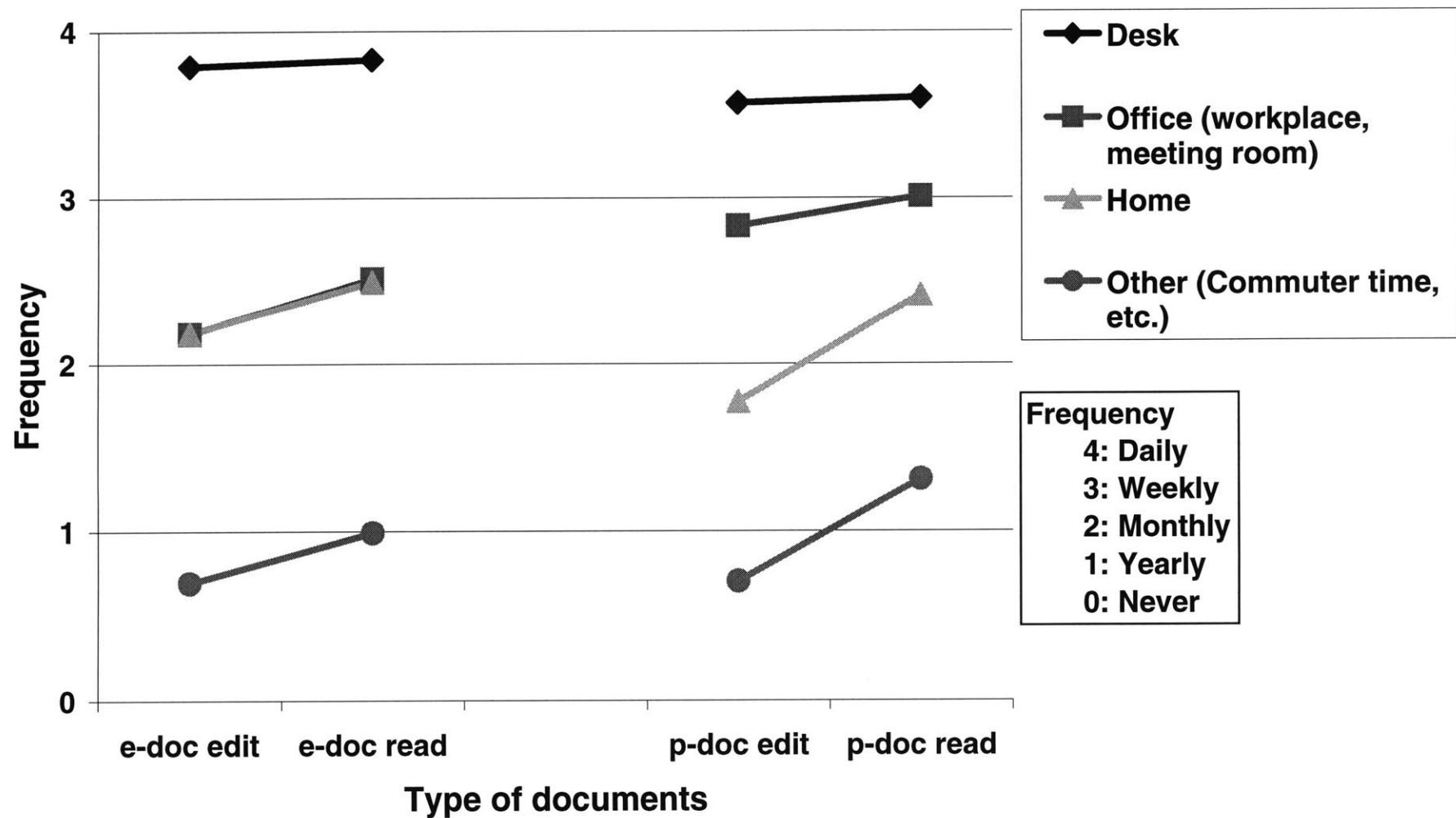
Applications frequency



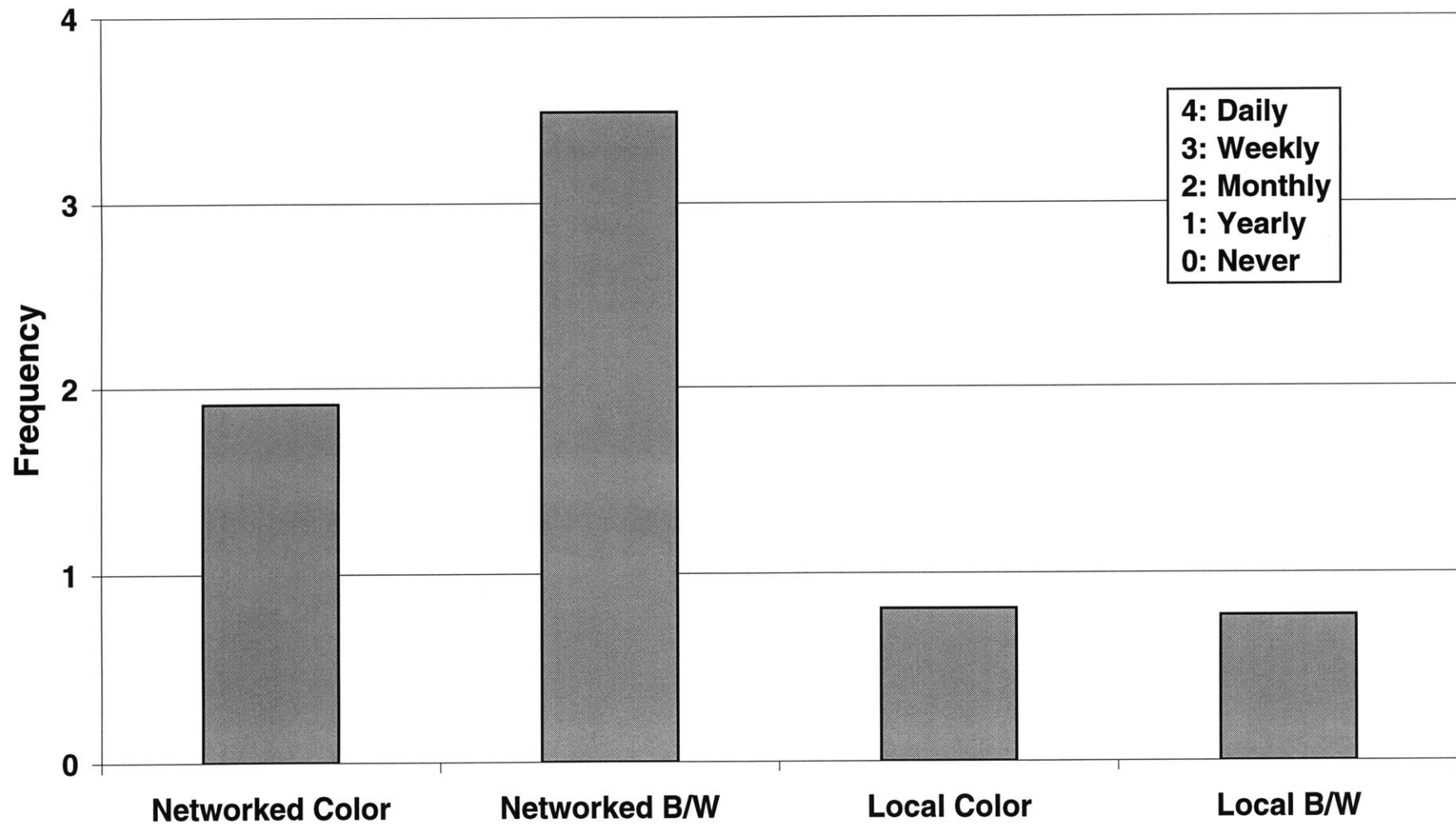
Audiences / Authors



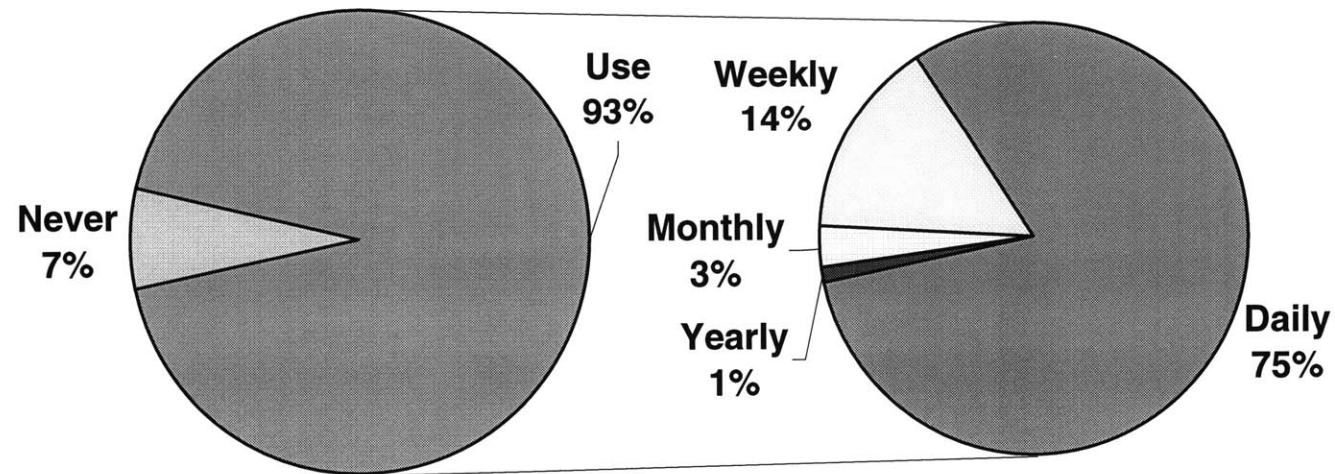
Edit/read document locations



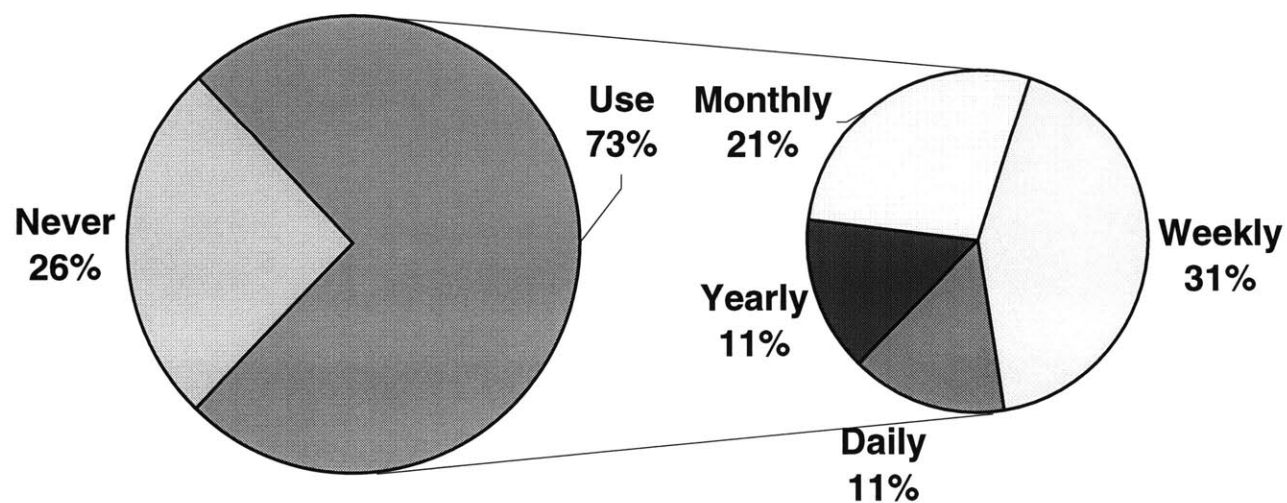
Type of printers



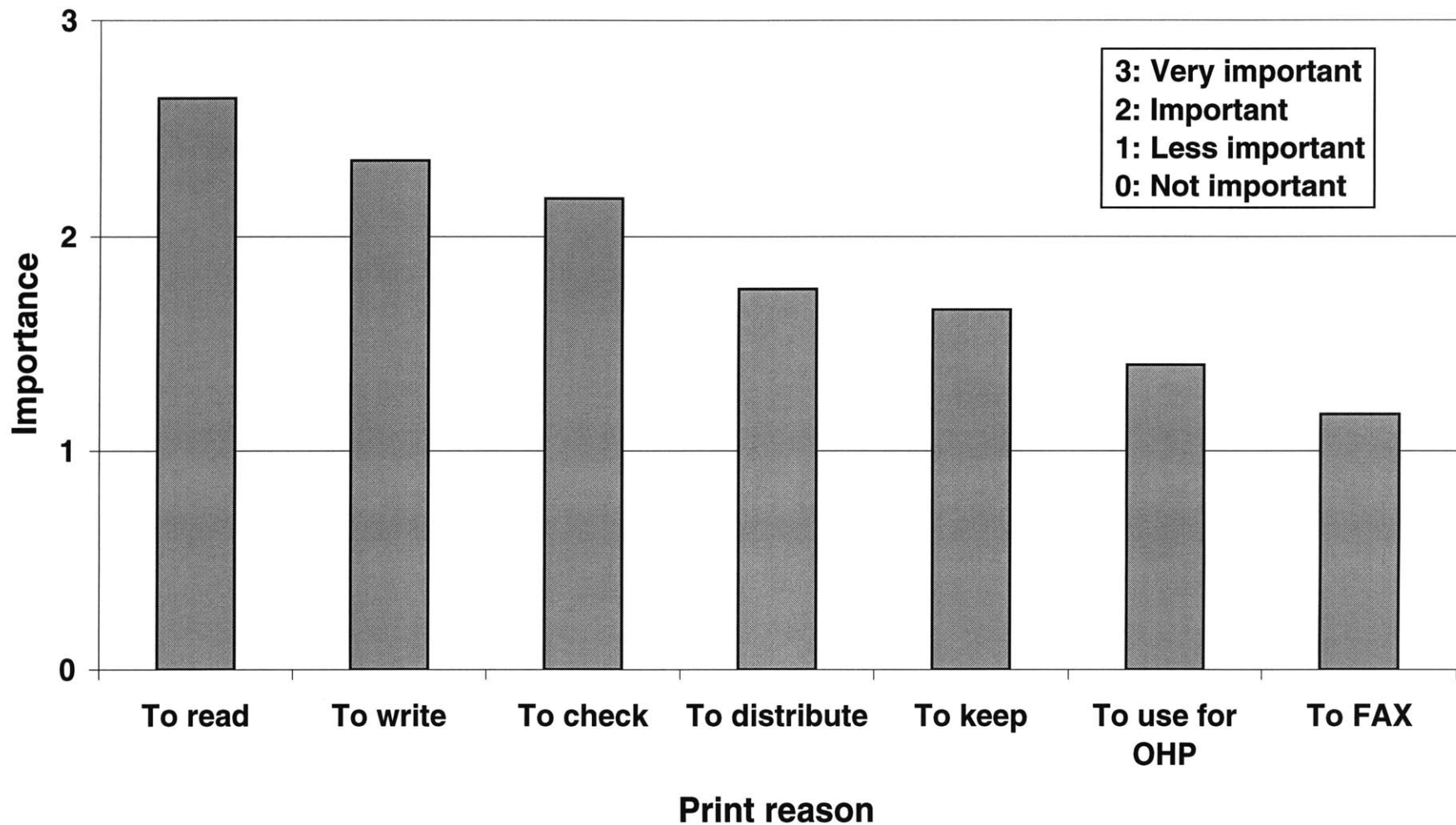
Networked B/W printer



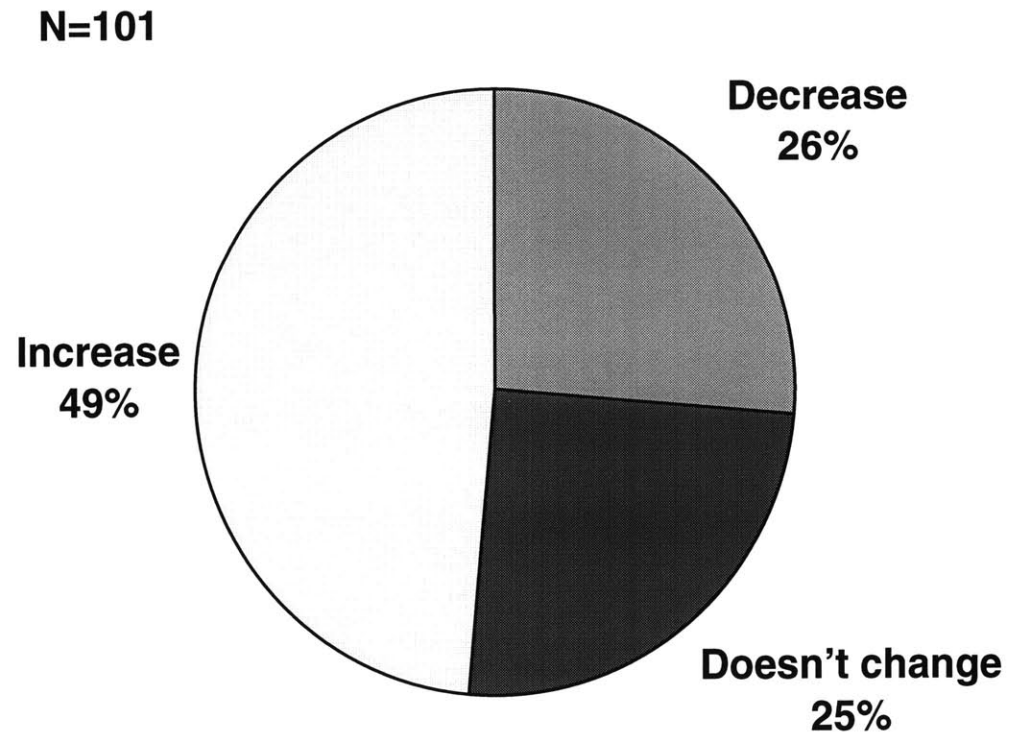
Networked color printer



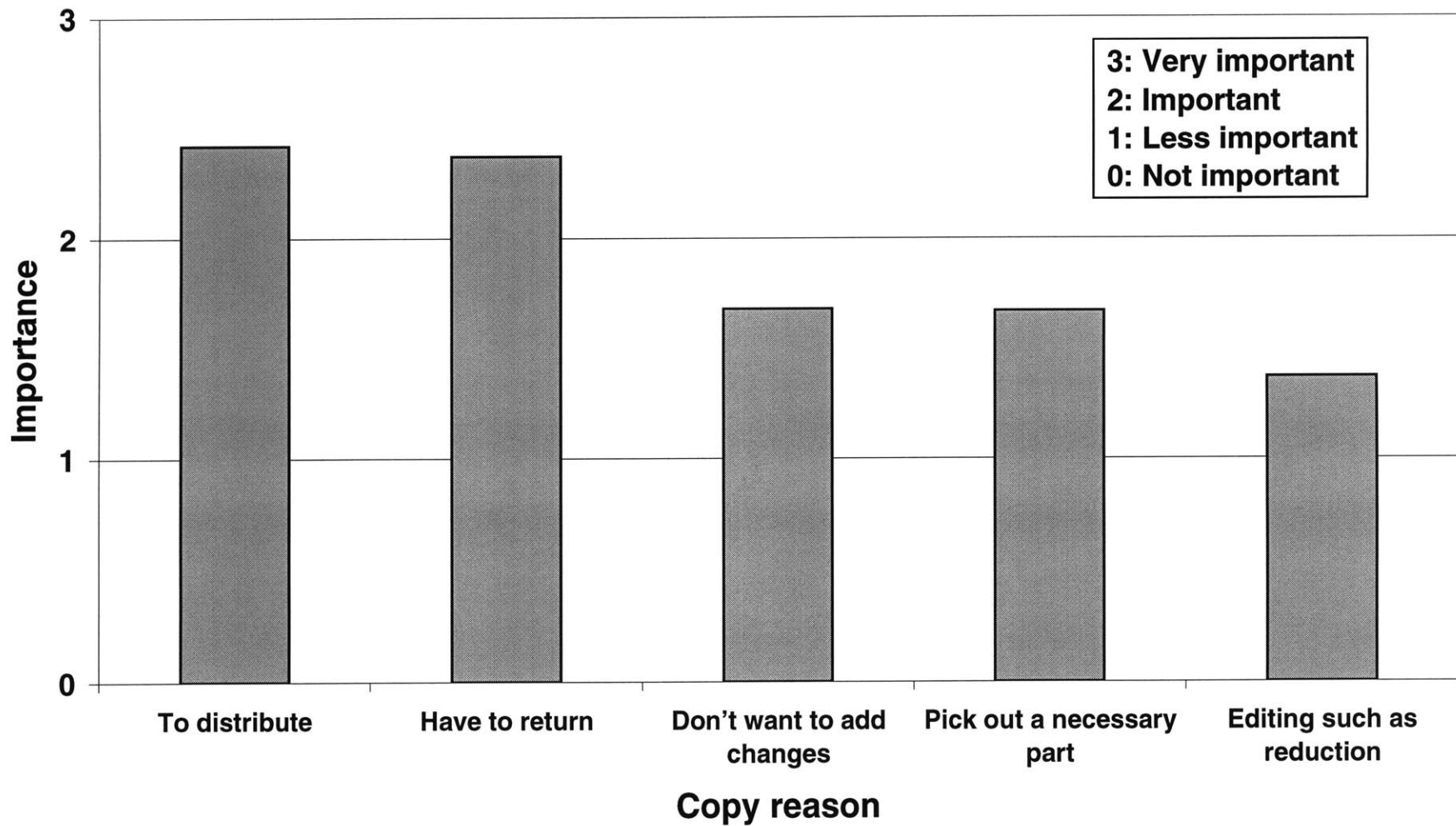
Reasons to print electronic documents



The quantity of printing over the past 5-6 years

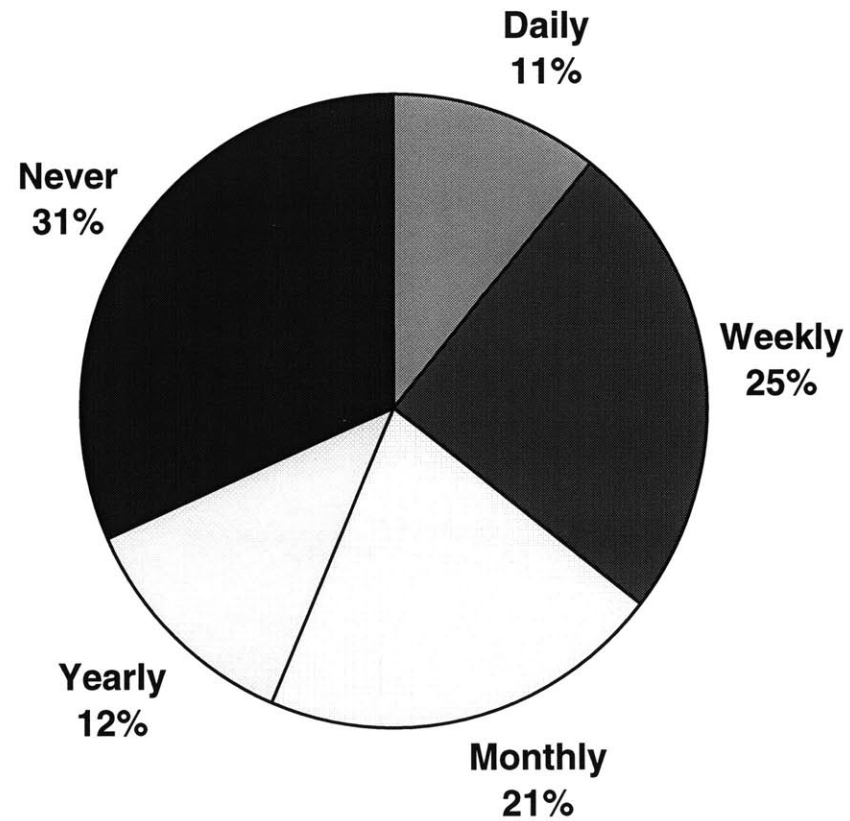


Reasons to copy paper documents

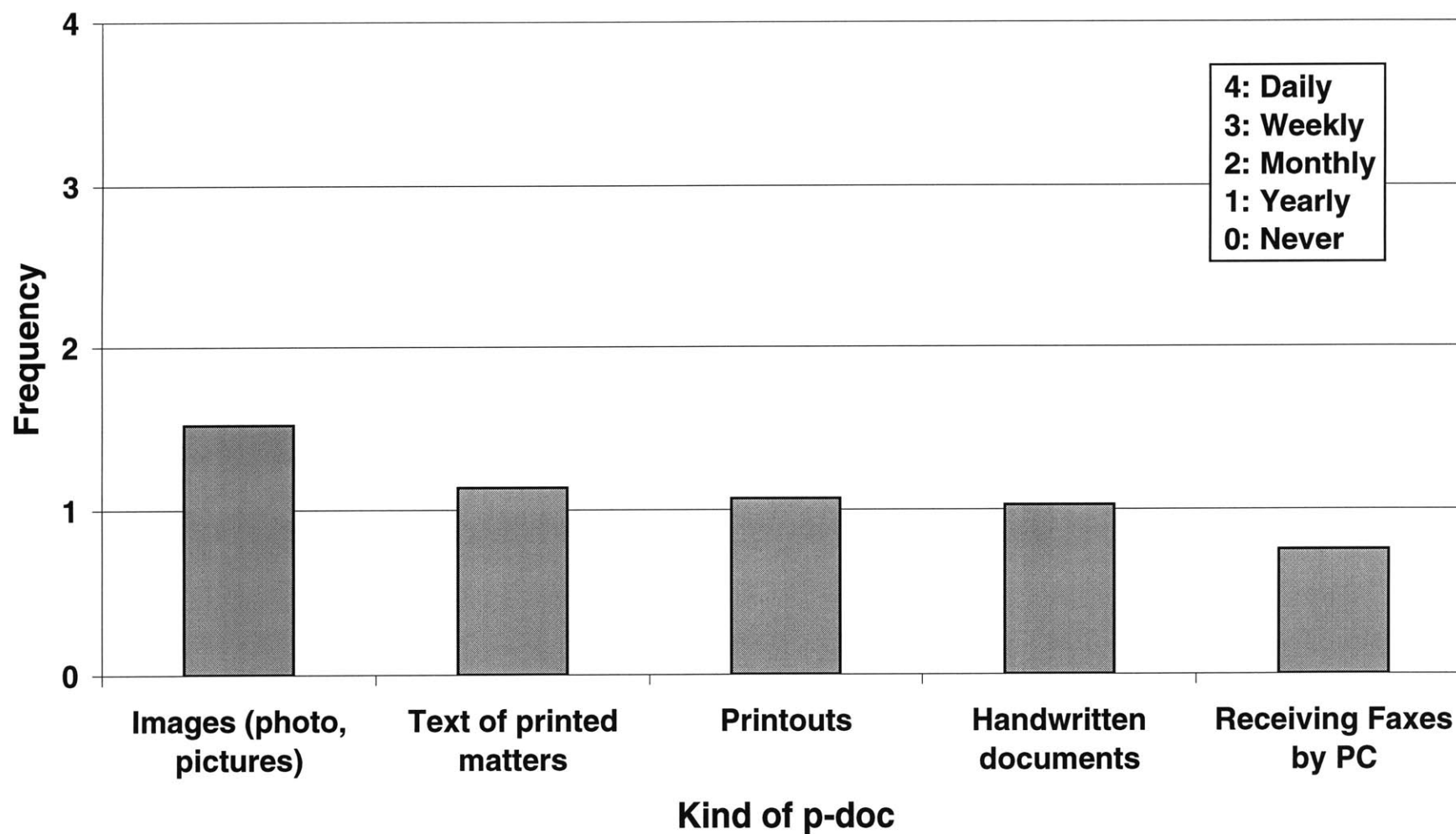


Frequency of capture paper documents

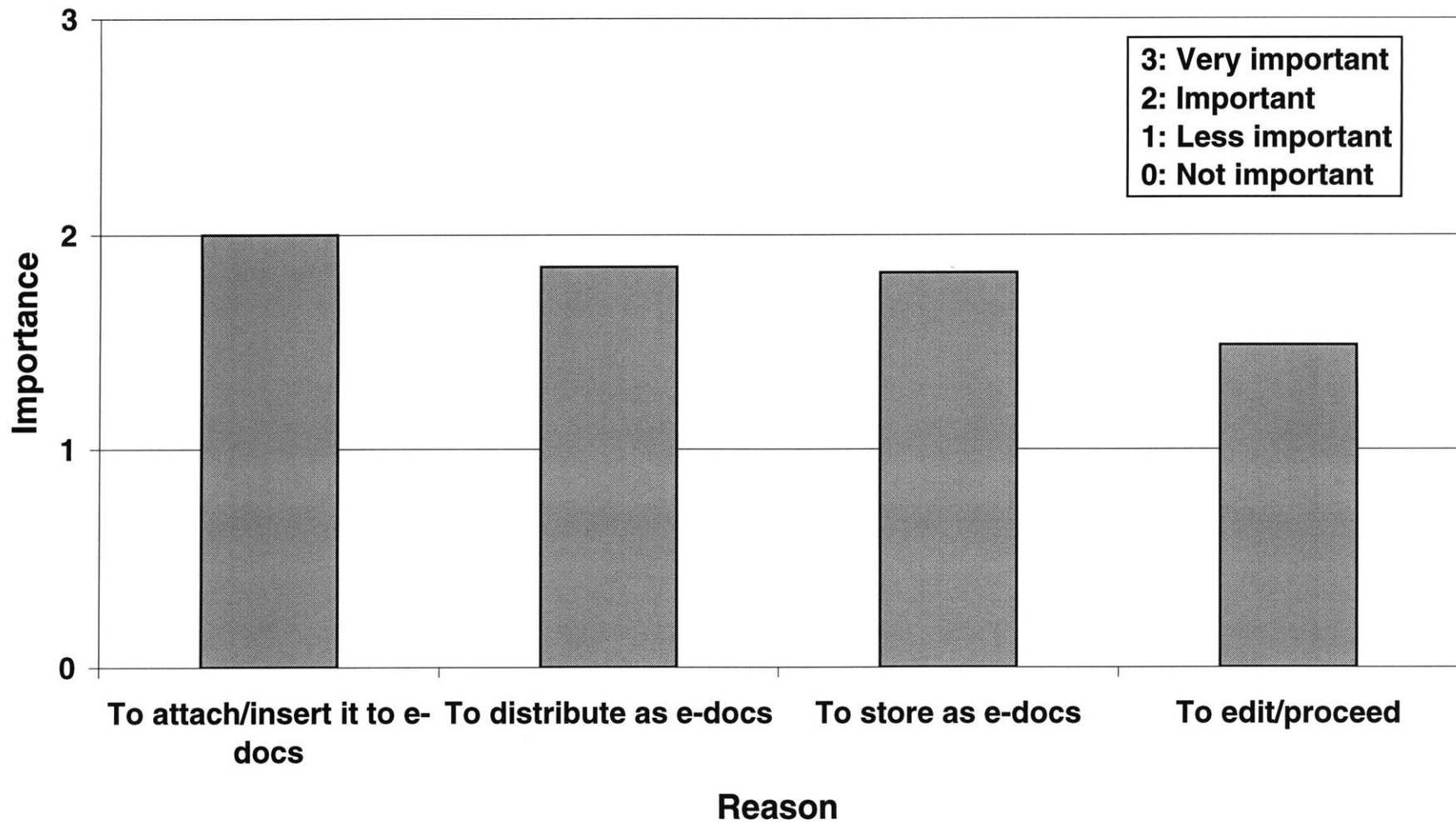
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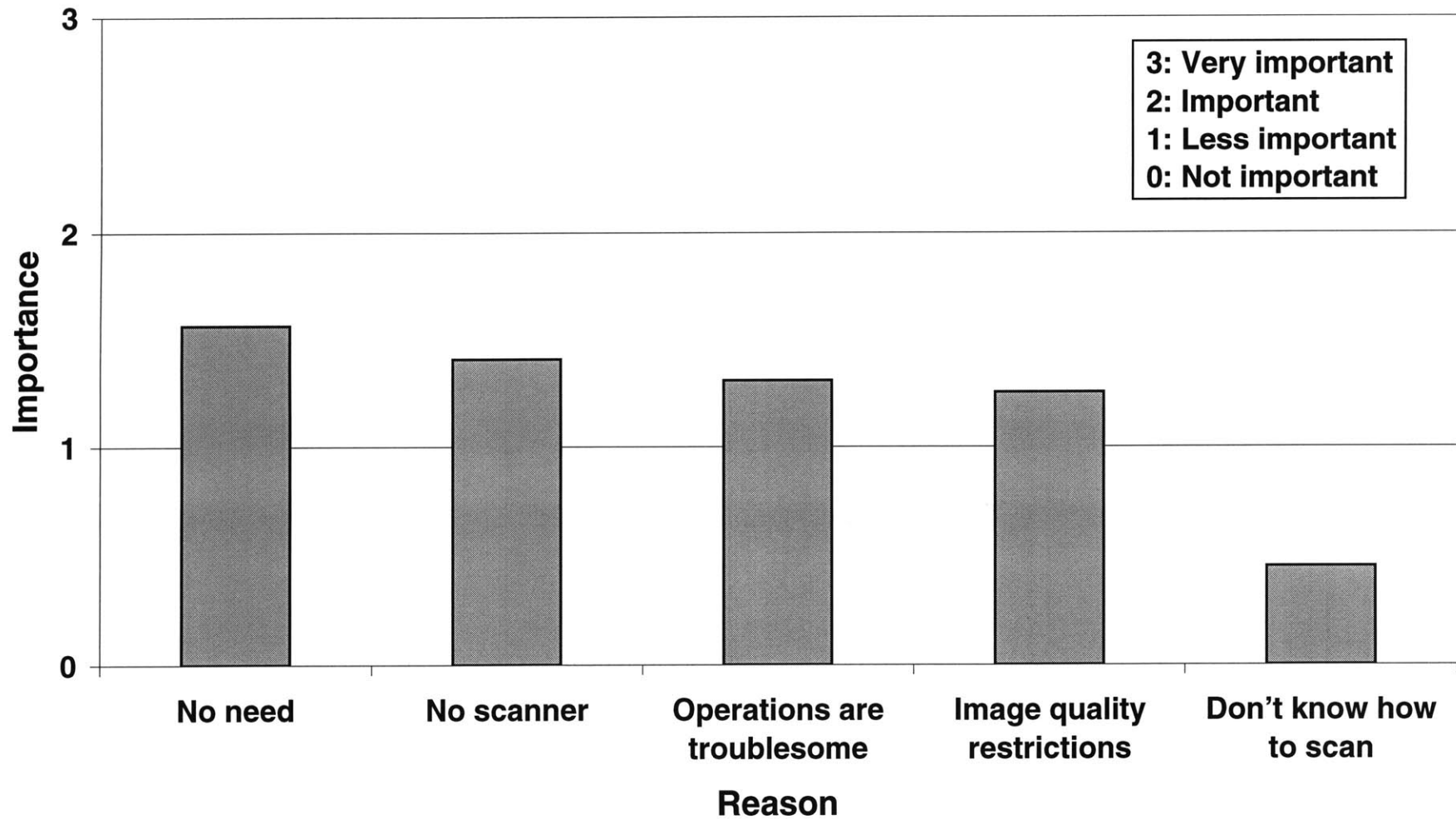
Kind of paper docs to capture in electronic docs



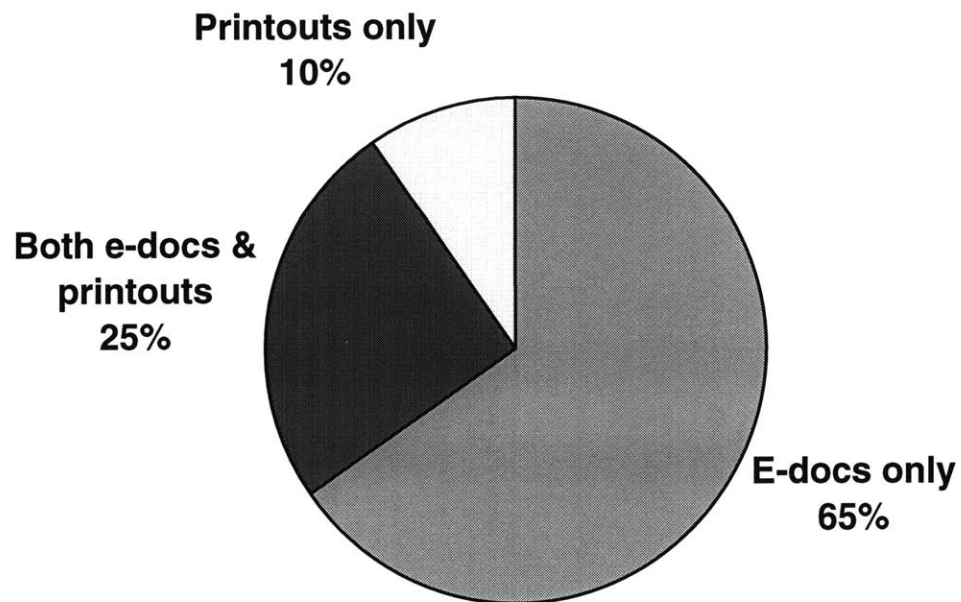
Reasons to capture paper documents



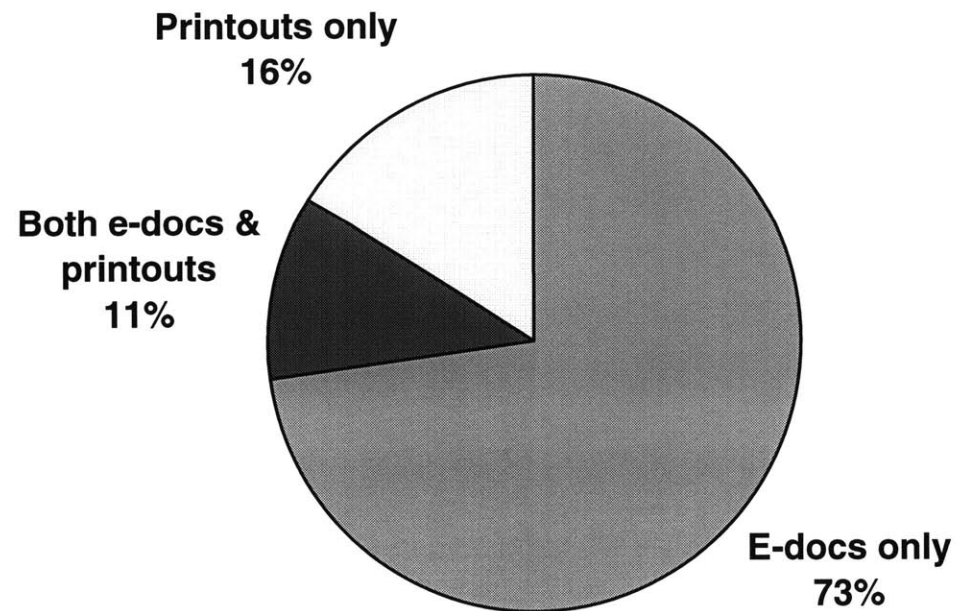
Reasons to not capture paper documents



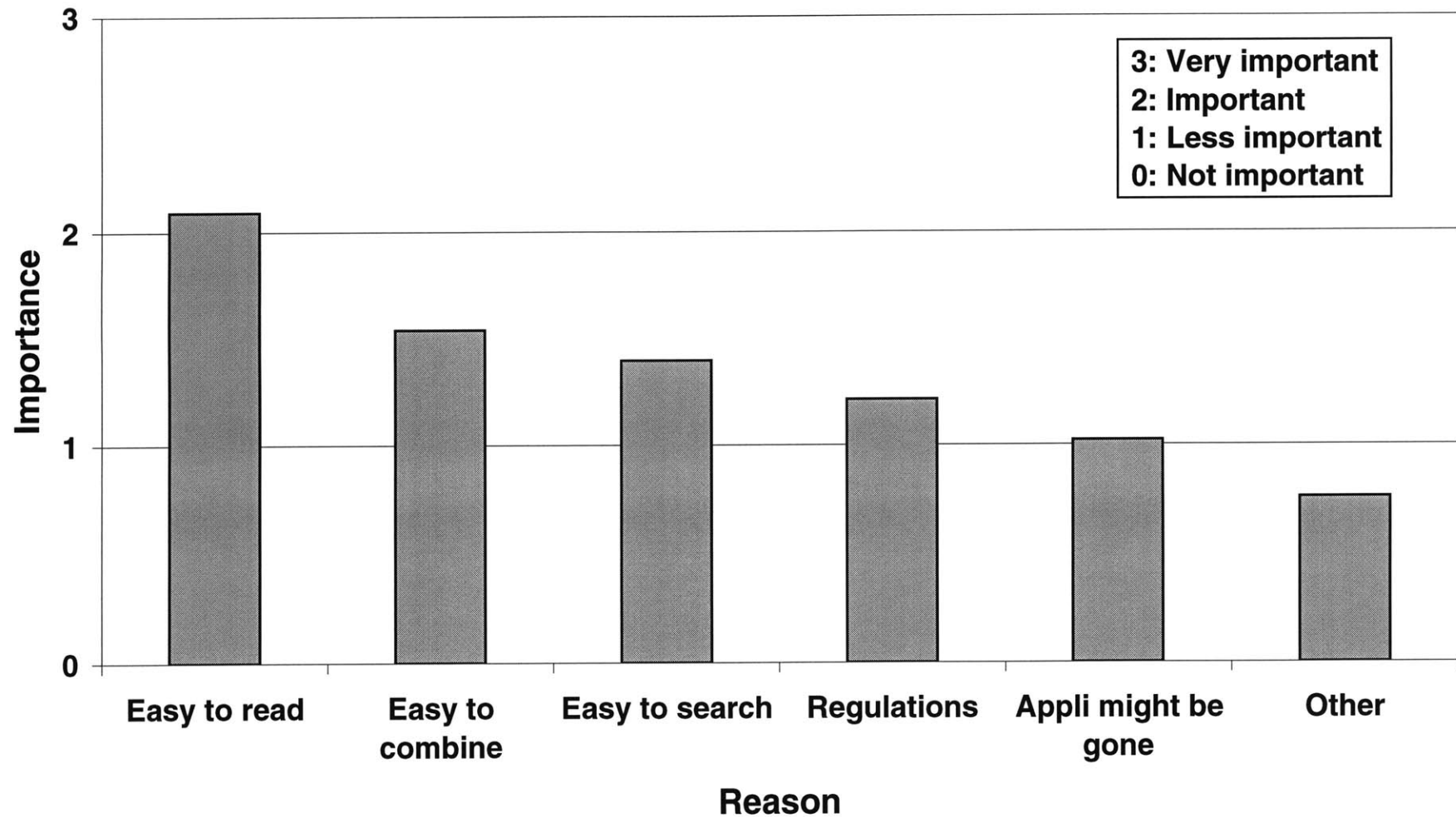
Methods to store electronic documents



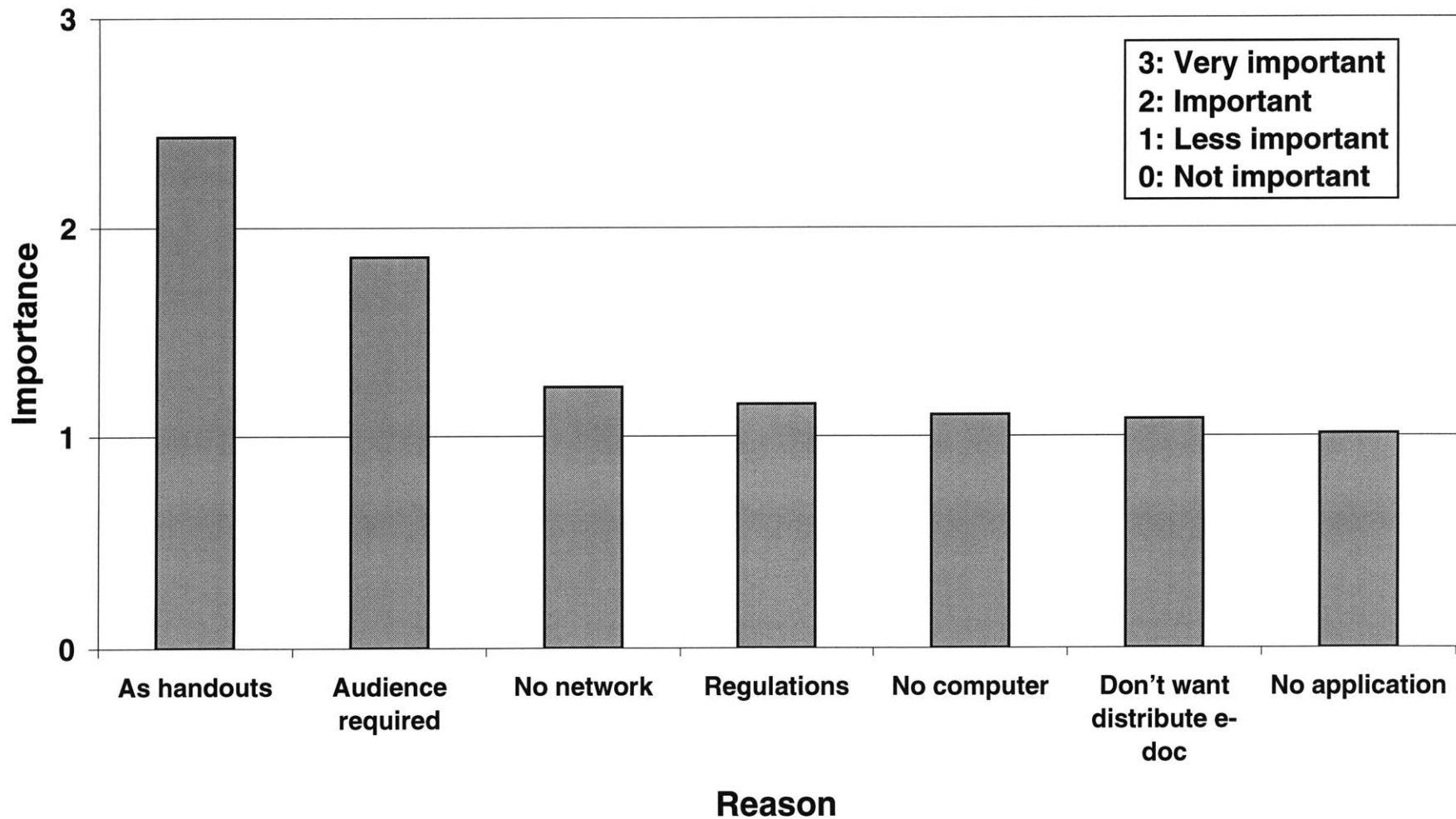
Methods to distribute electronic documents



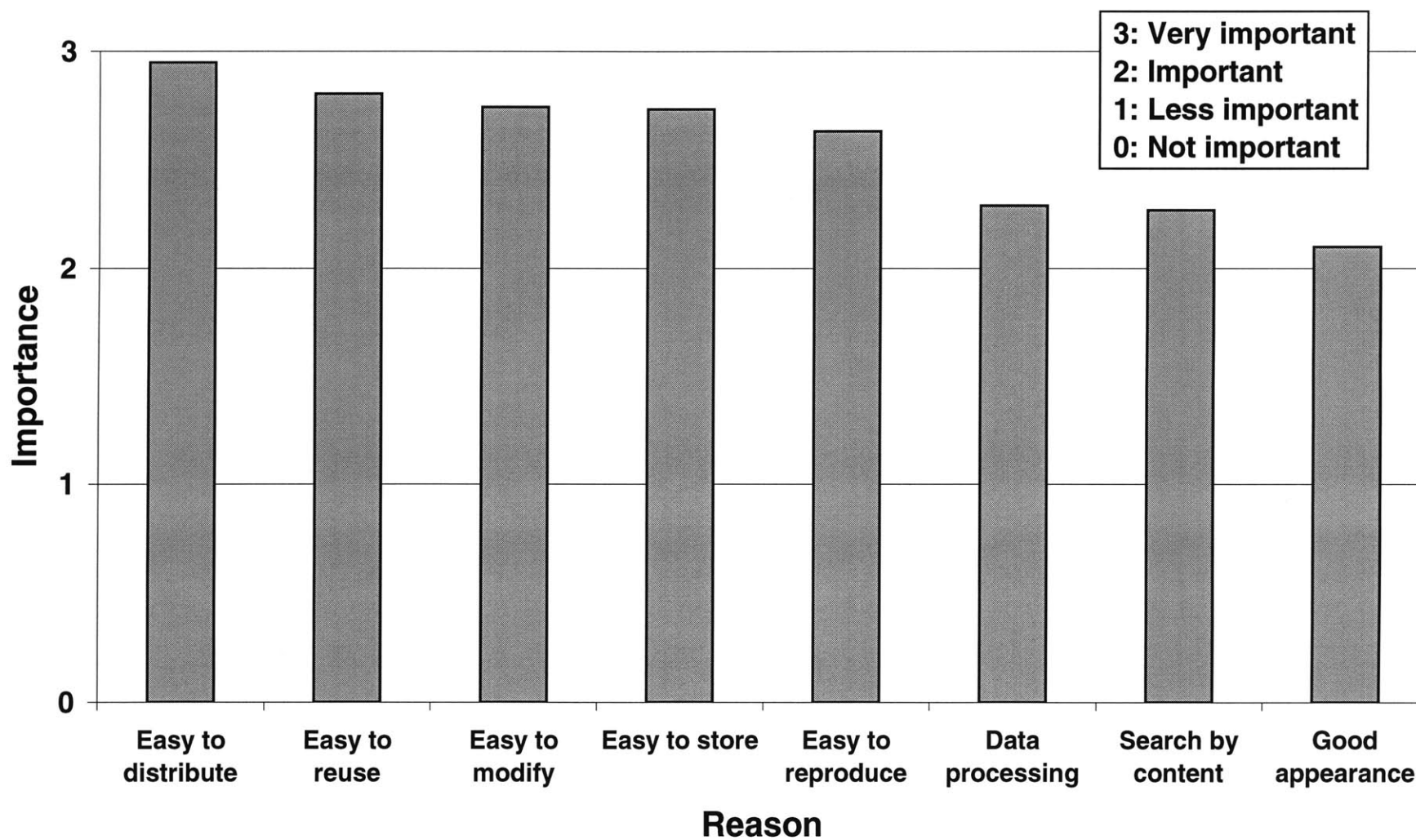
Reasons to store printouts of some electronic documents



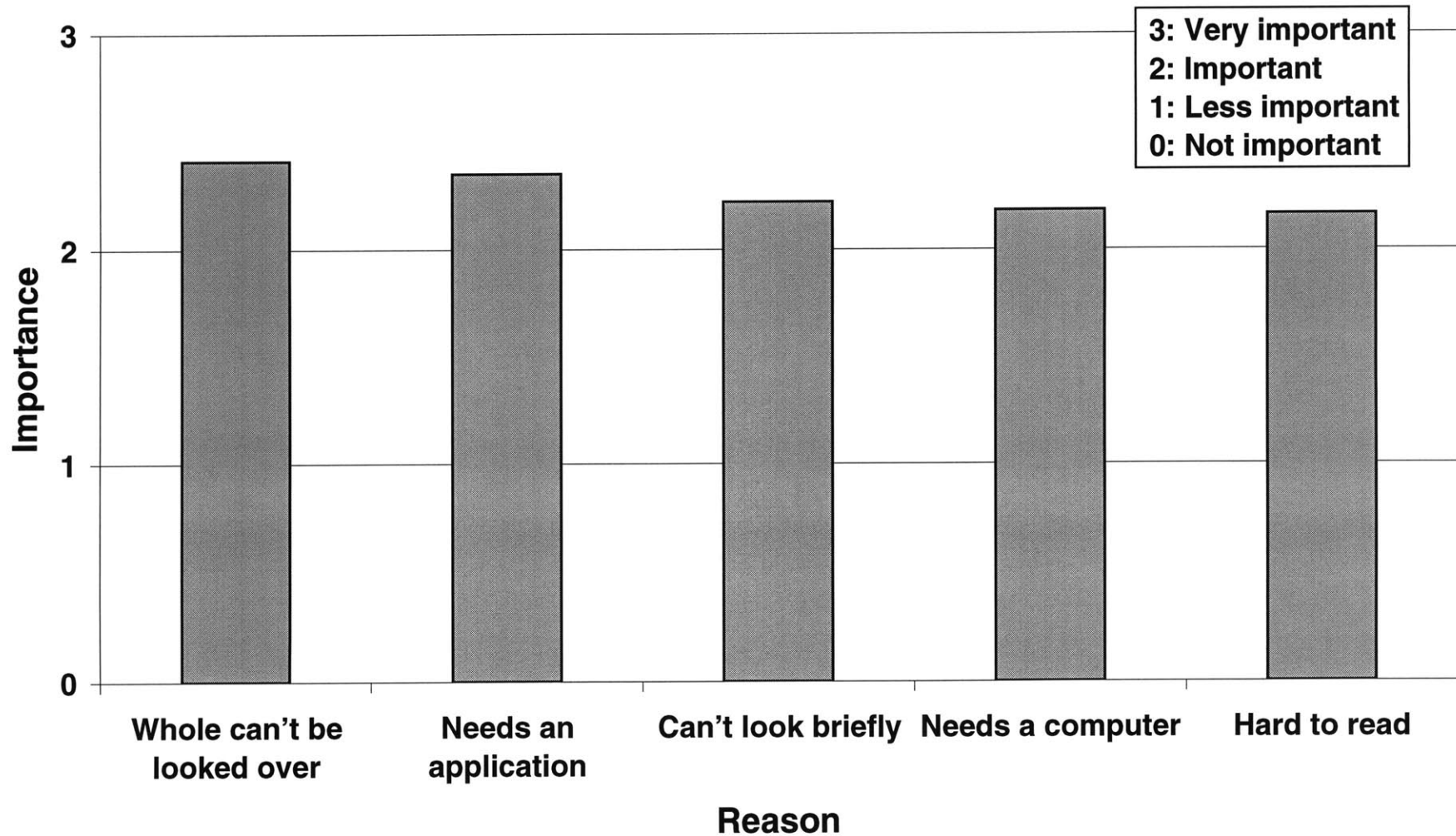
Reasons to distribute printouts of some electronic docs



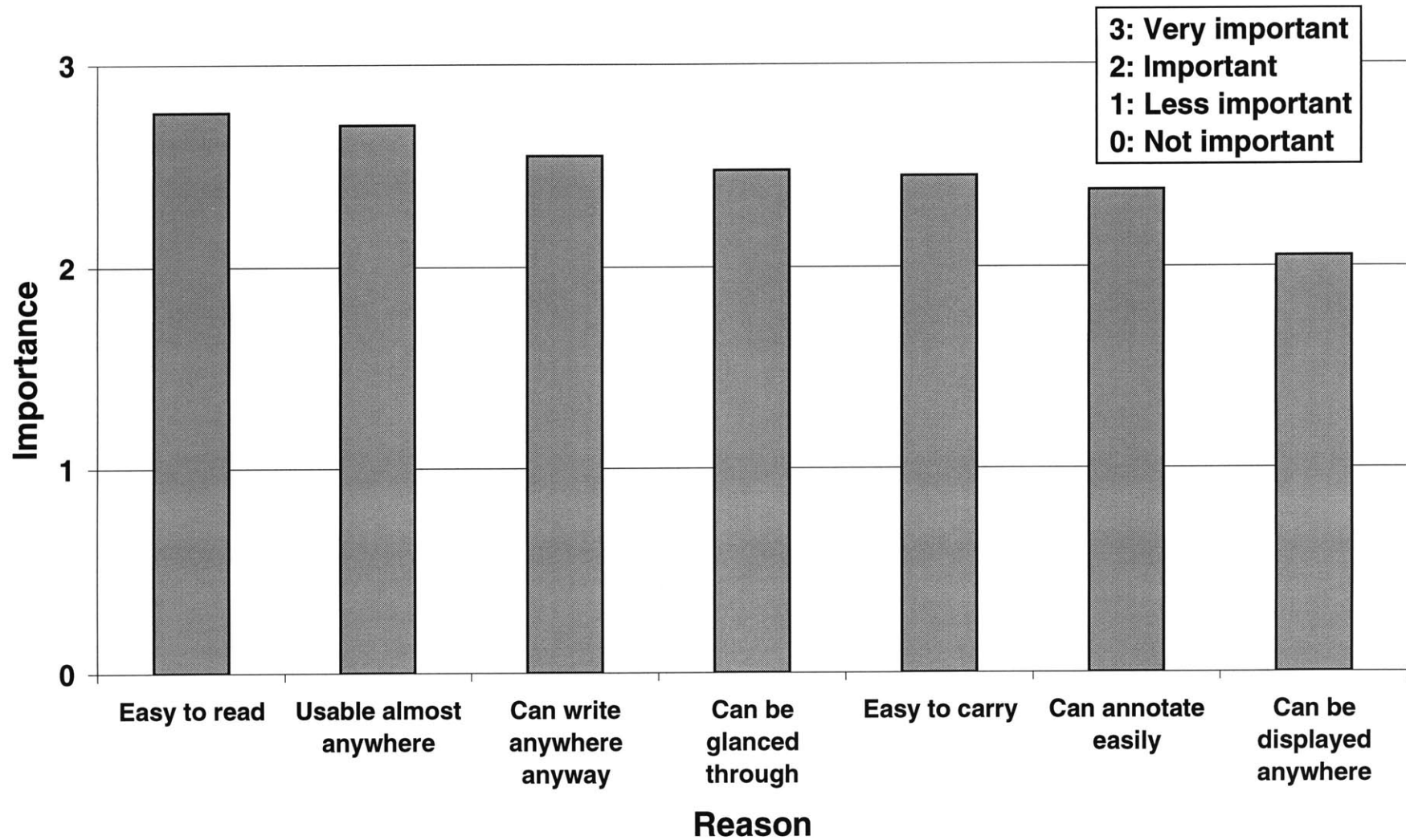
The advantages of electronic documents



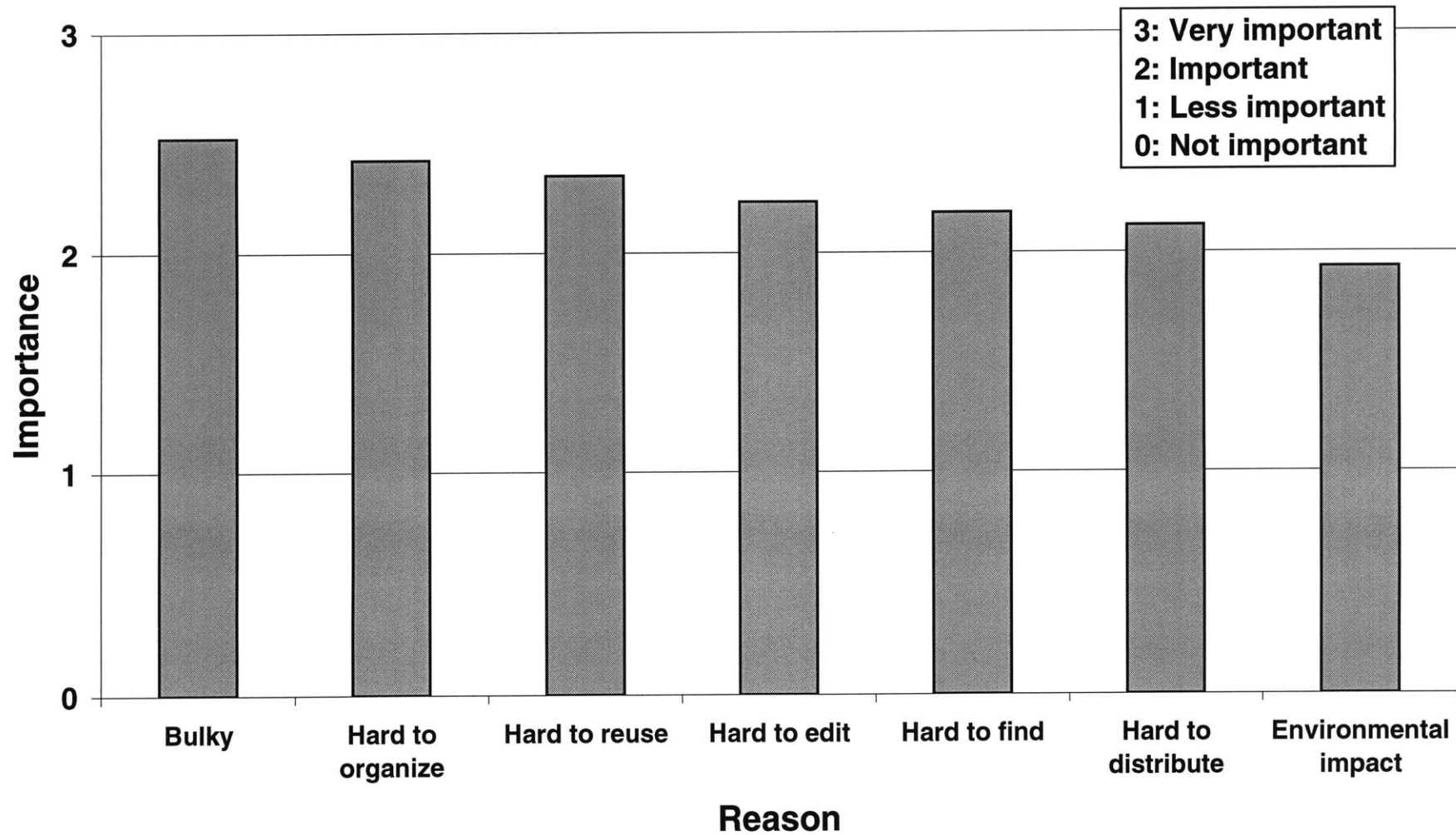
The disadvantages of electronic documents



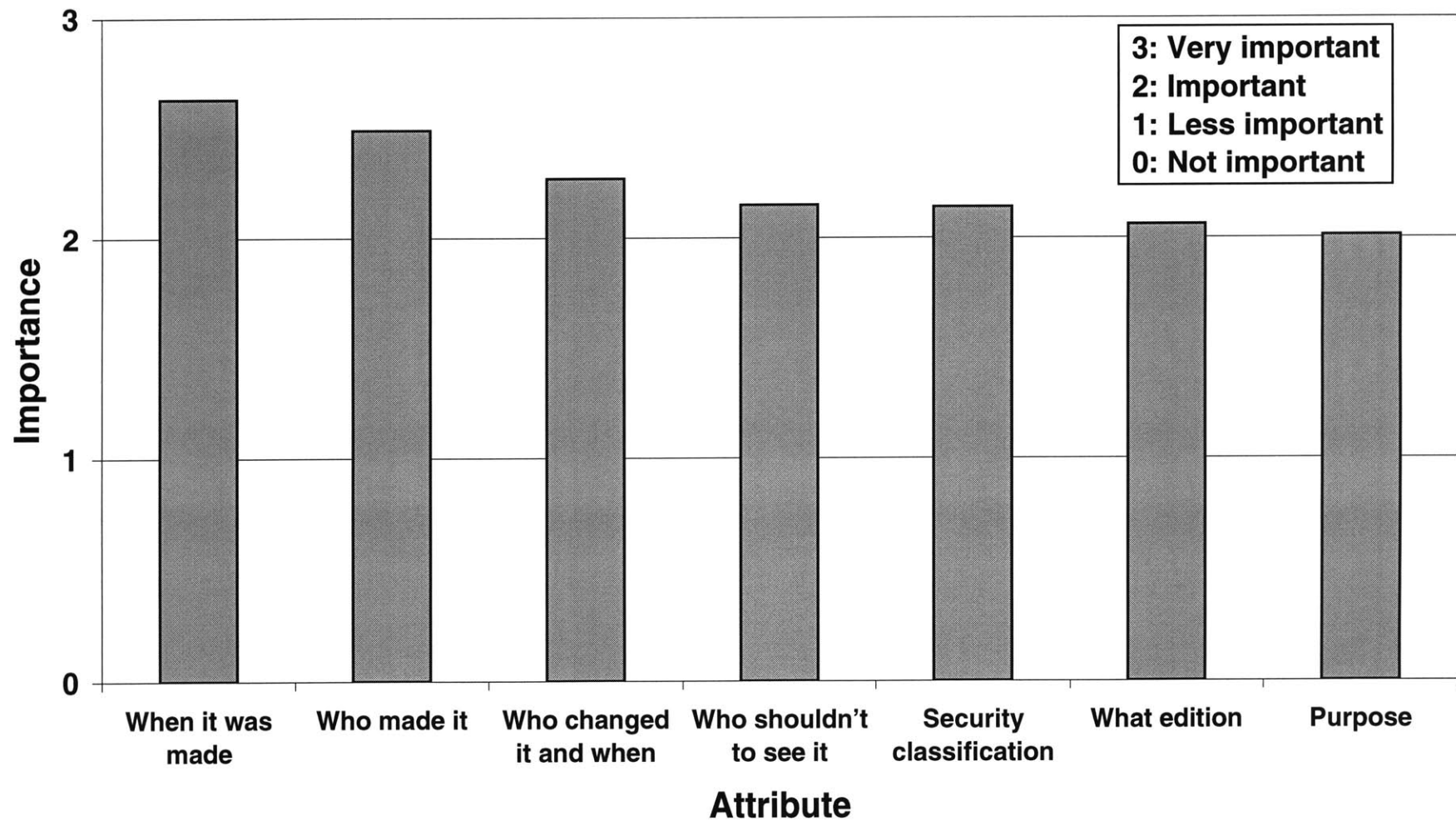
The advantages of paper documents



The disadvantages of paper documents

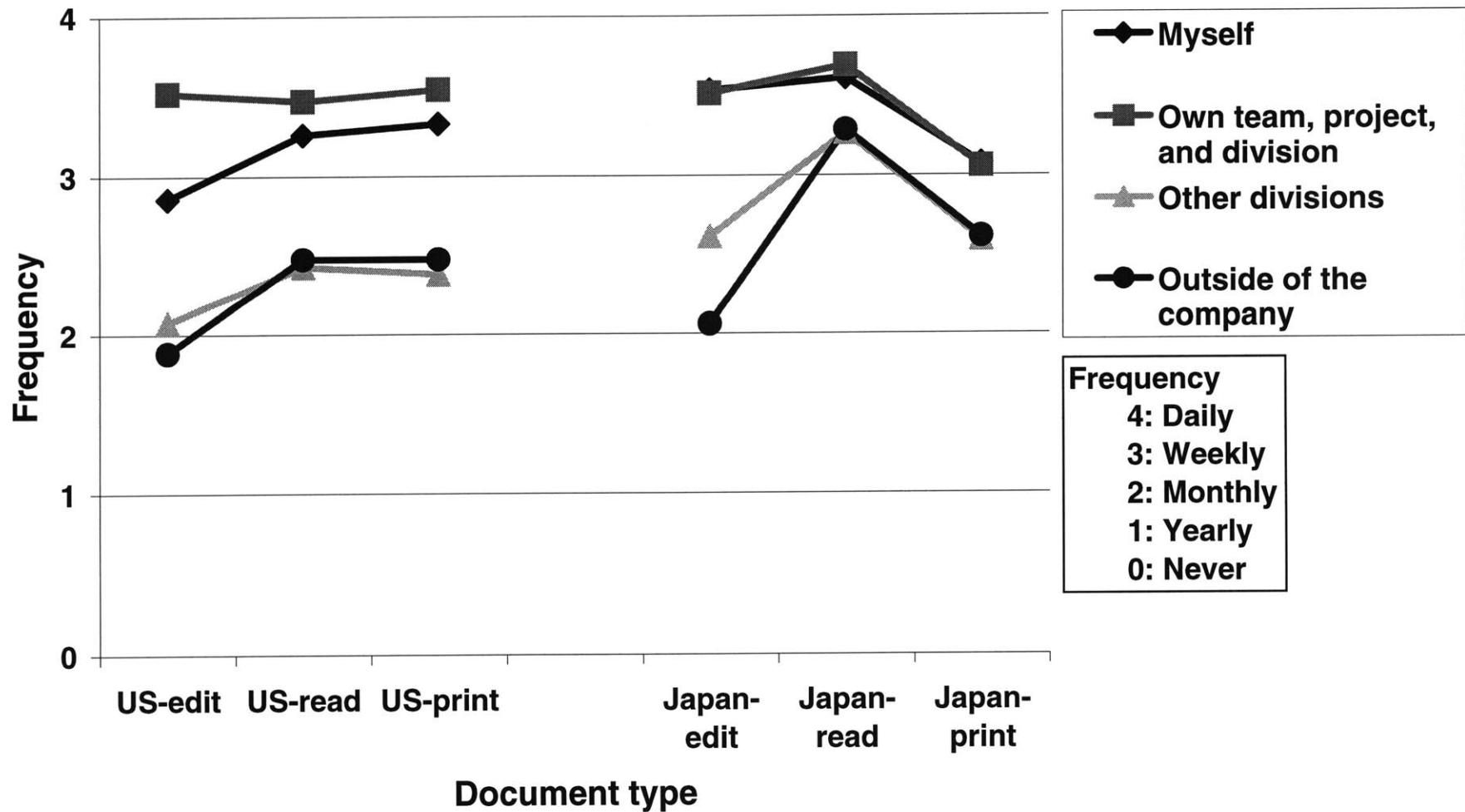


Necessary attributes information

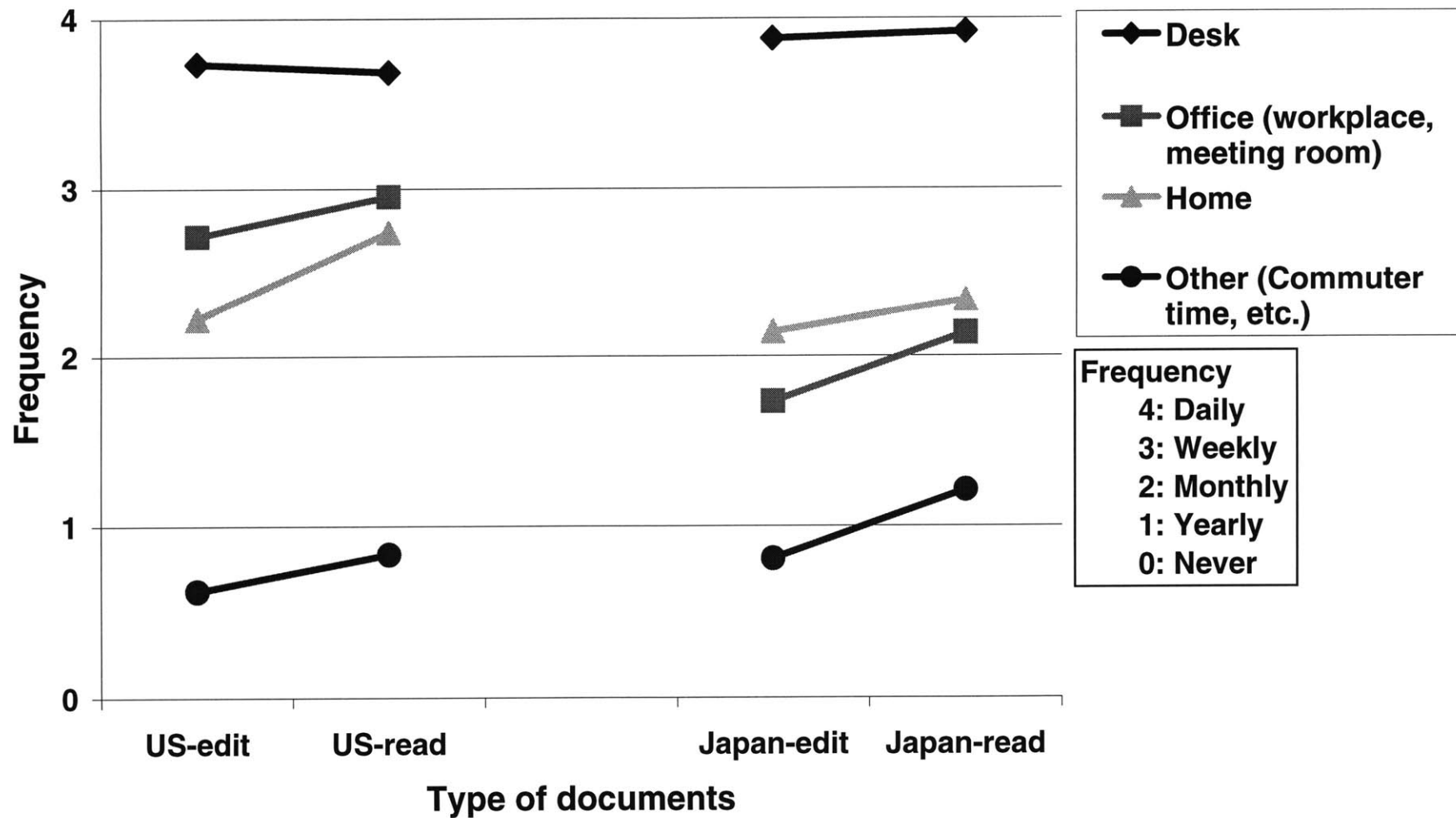


Appendix 4: Results of the survey (US vs. Japan)

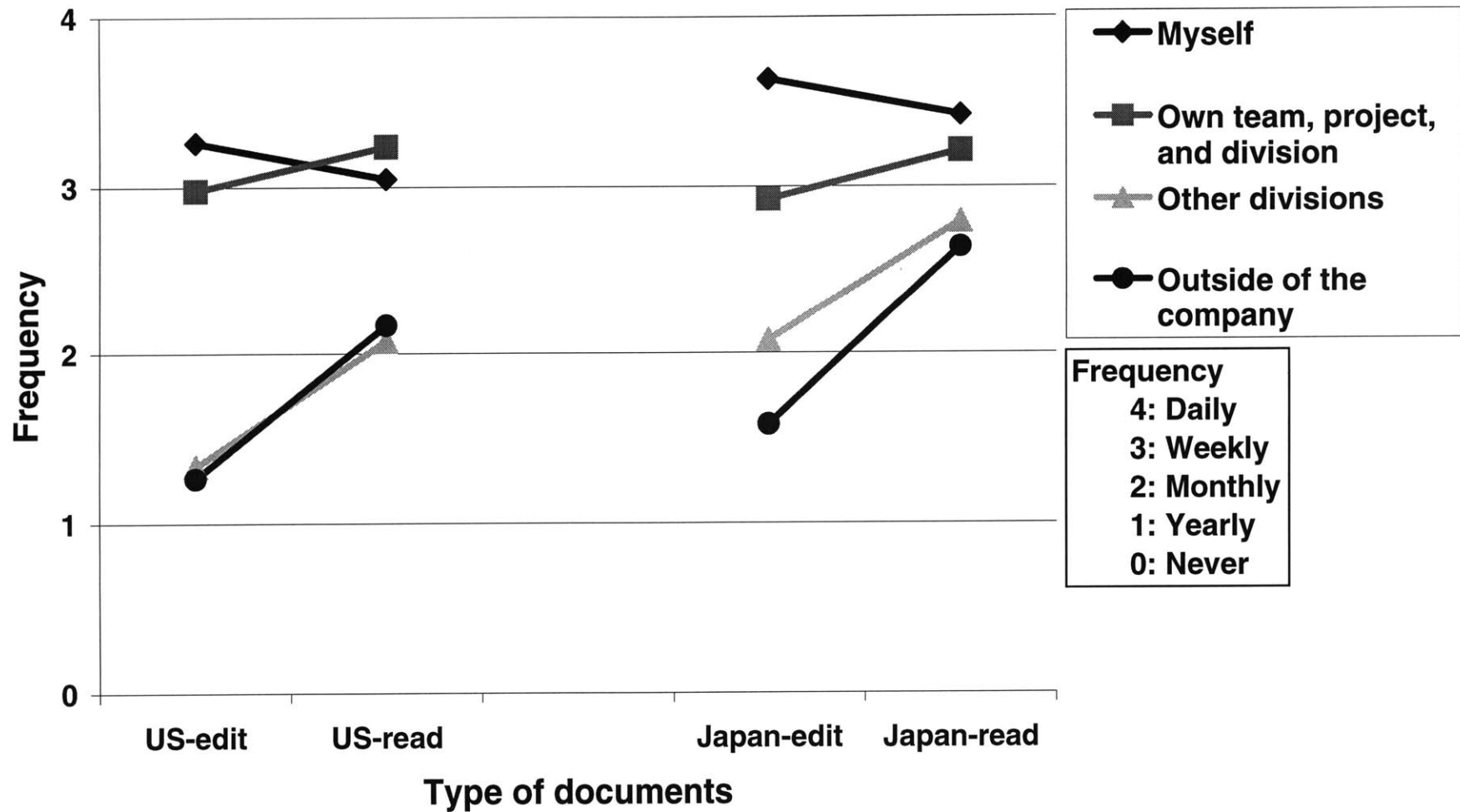
Audiences / Authors for electronic documents



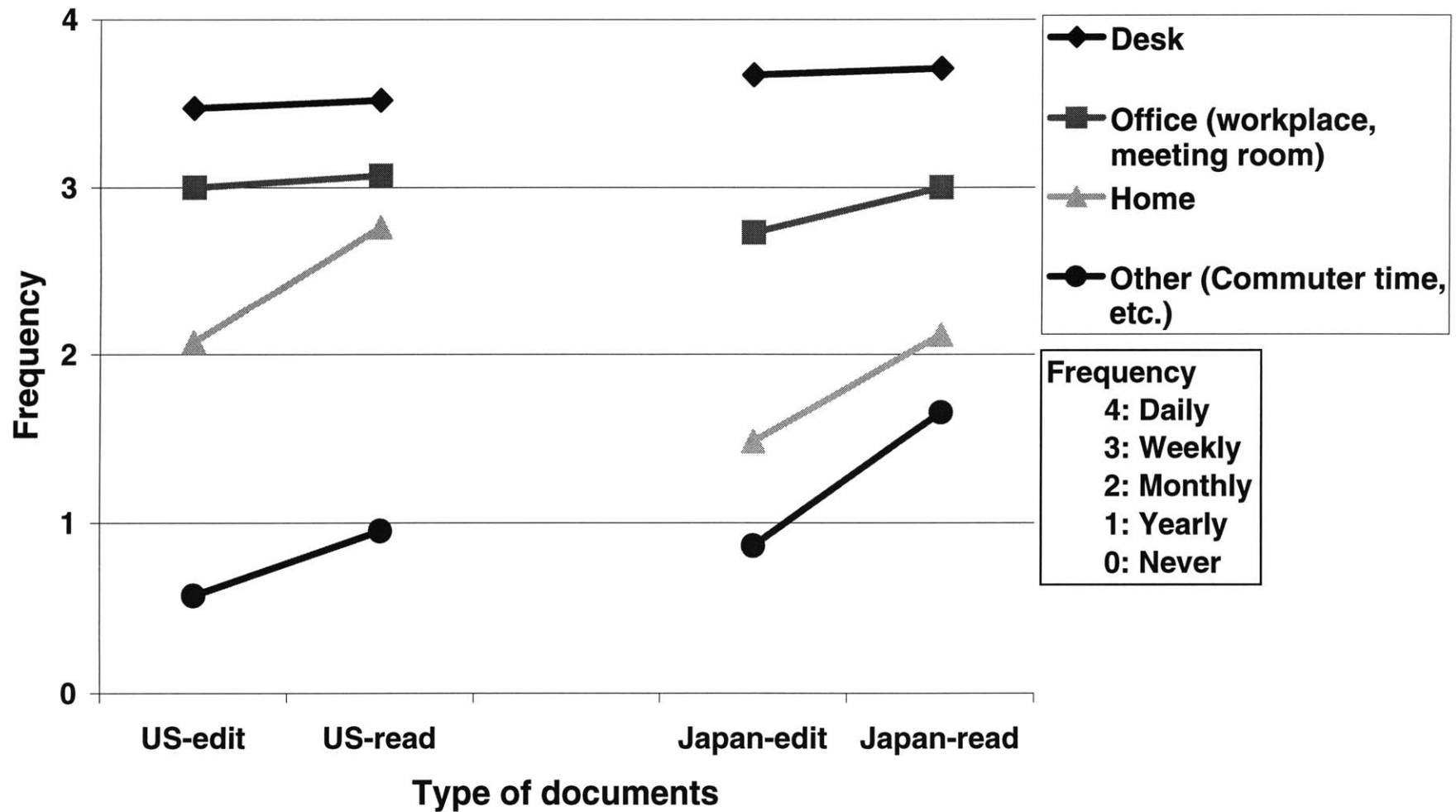
Locations for electronic documents

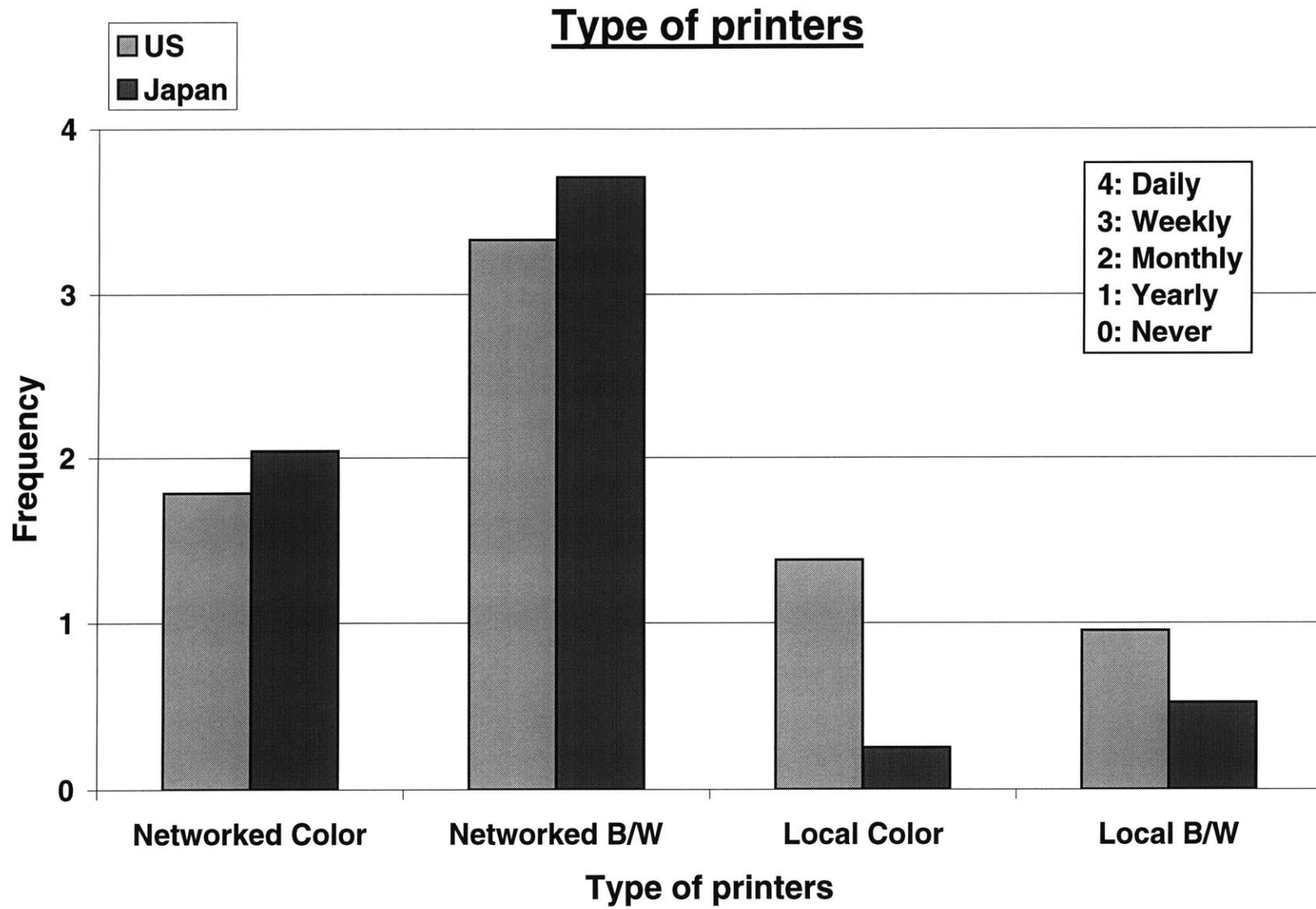


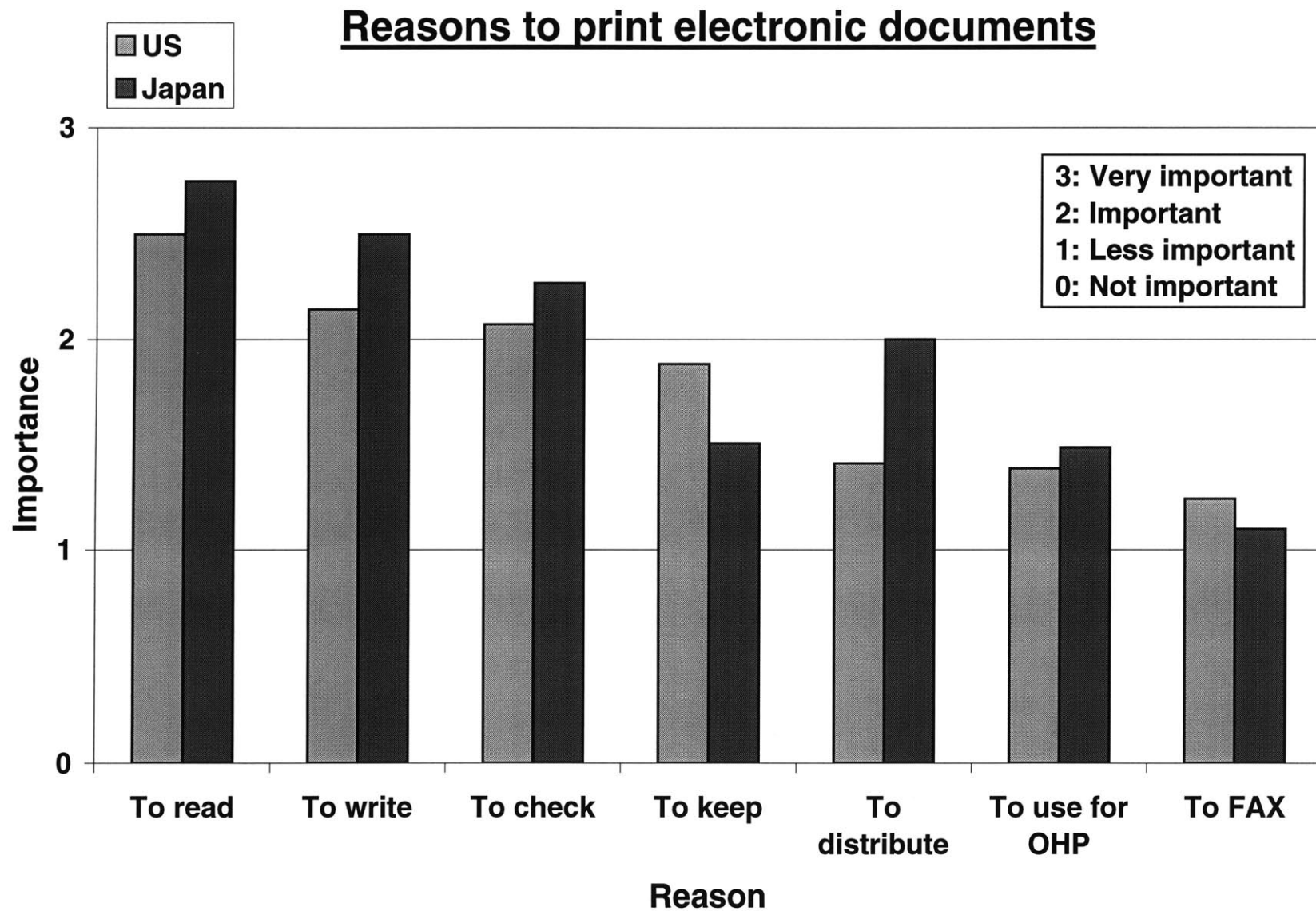
Audiences / Authors for paper documents



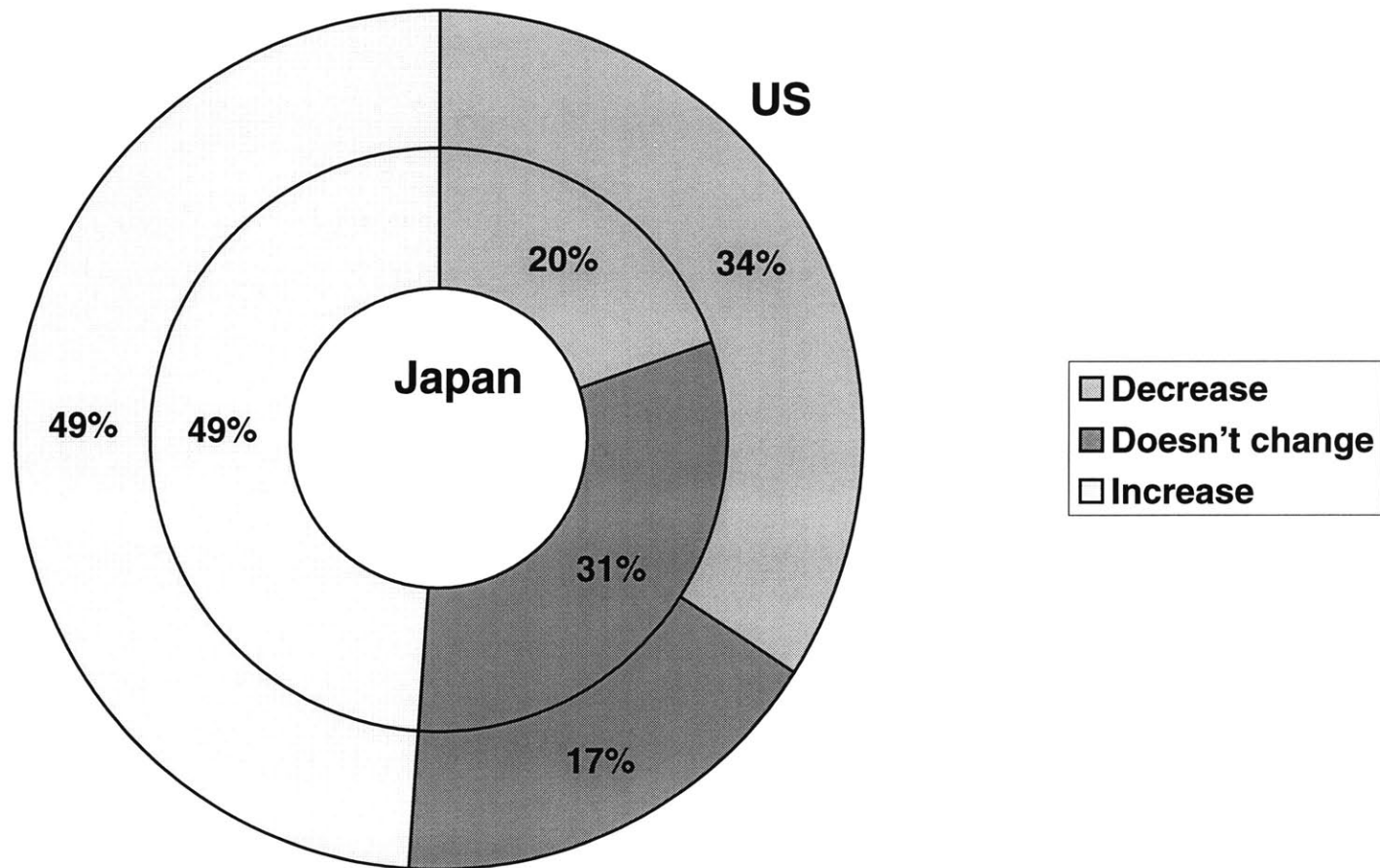
Locations for paper documents

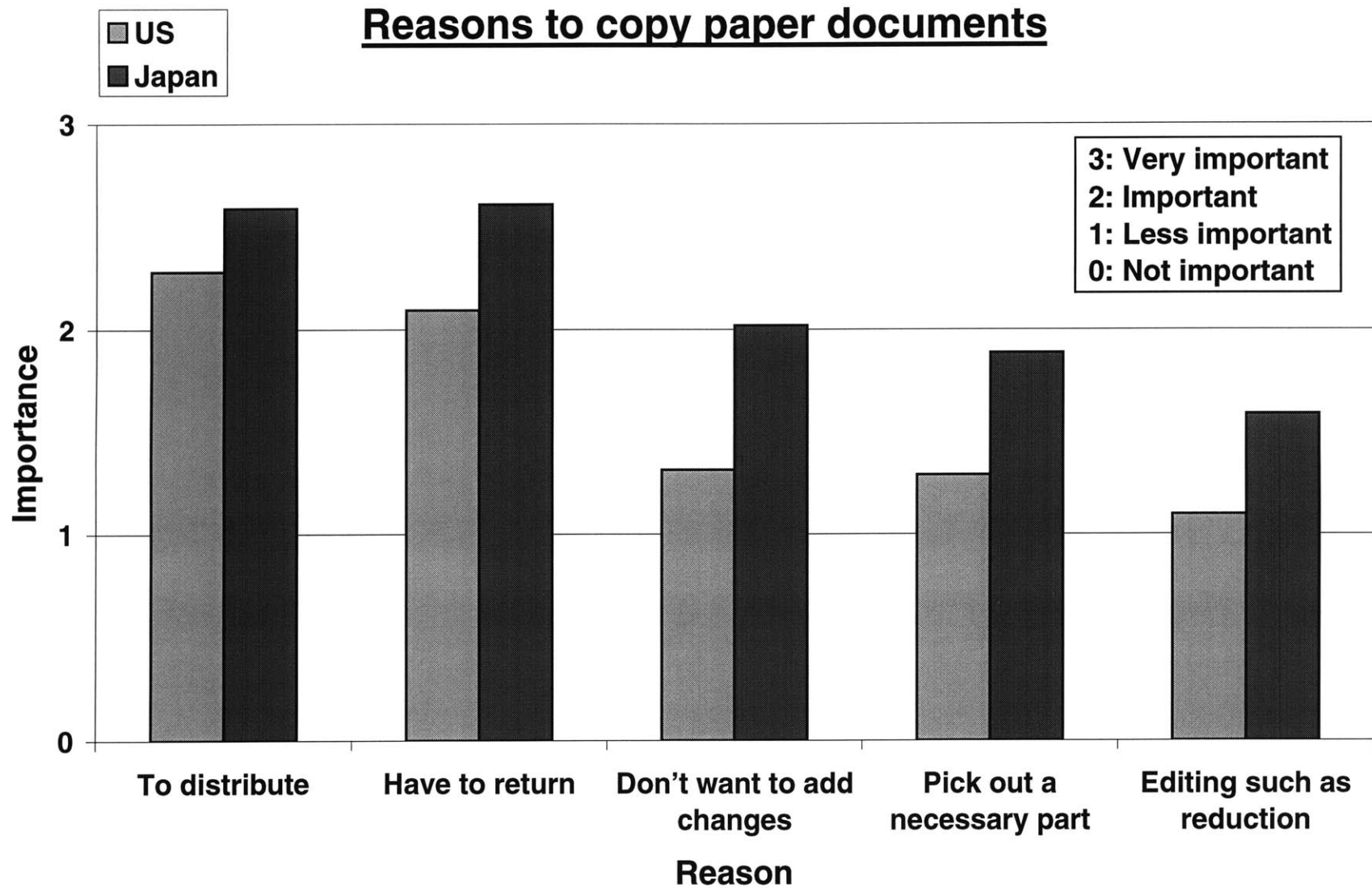




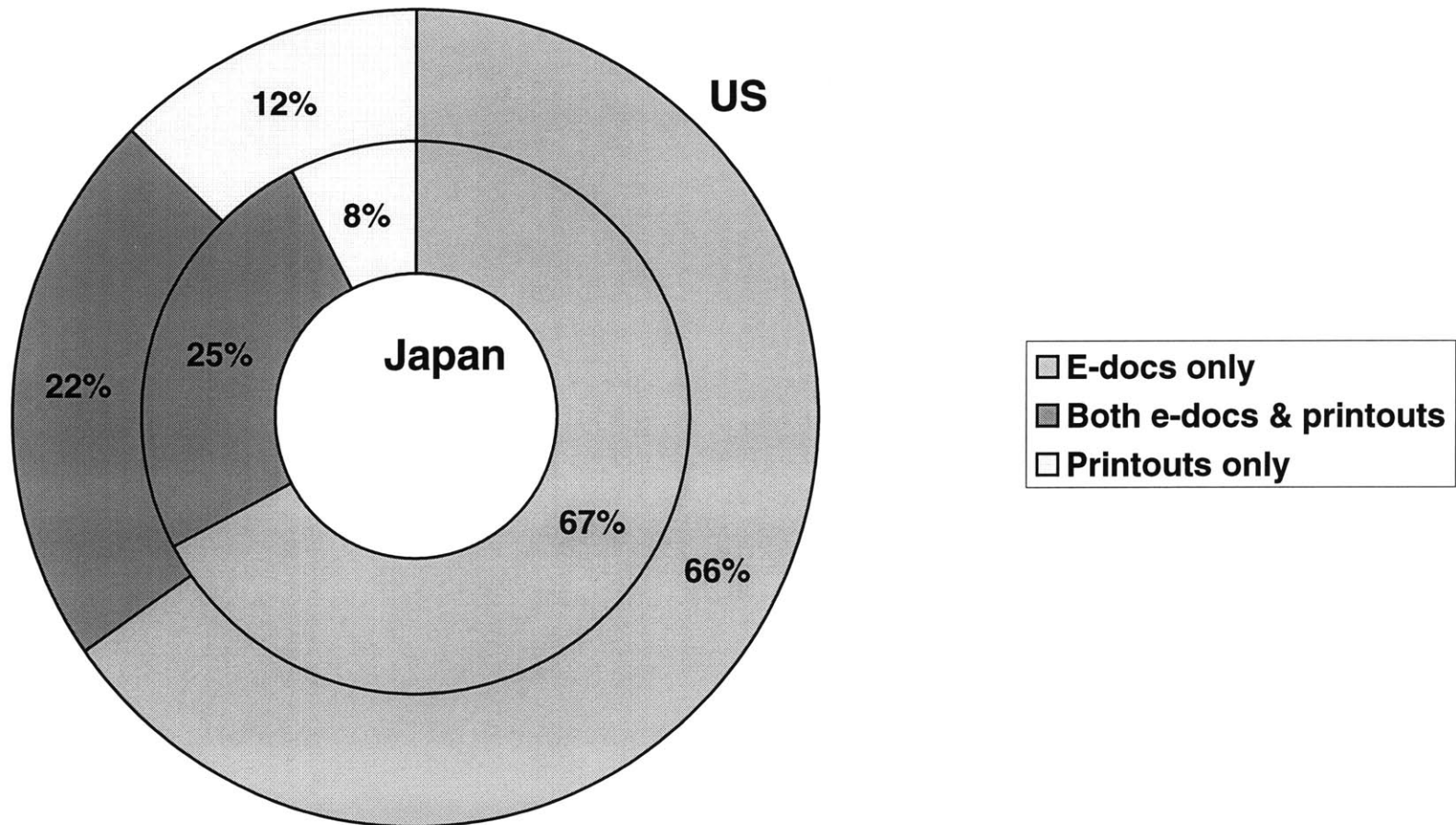


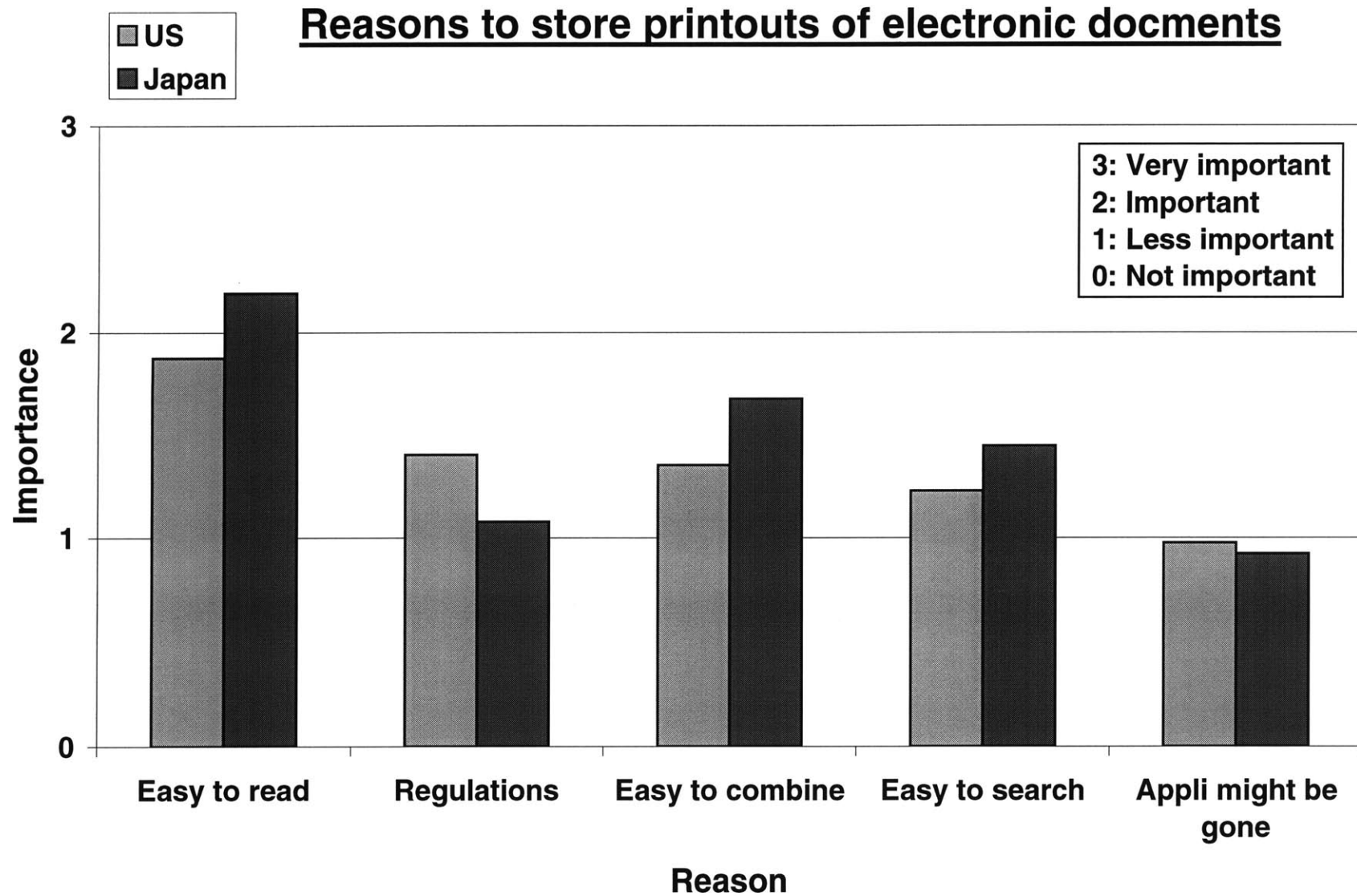
The quantity of printing over the past 5-6 years





Methods to store electronic documents





Methods to distribute electronic documents

